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Taxonomy and distribution of sea anemones (Cnidaria: Actiniaria and Corallimorpharia) from deep water of the northeastern Pacific

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Abstract

Sea anemones *sensu lato* (members of cnidarian orders Actiniaria and Corallimorpharia) occurring in water of the northeastern Pacific Ocean greater than 1,000 m (to the abyssal plain) are poorly known. Based on the literature and specimens we examined in the four largest collections of animals from this area, we estimate that approximately 35 species occur in these deep-water habitats and fewer than half have been documented there. Of the largest and most abundant epibenthic species, based on morphology, we identified two species of Corallimorpharia (both previously known) and 12 of Actiniaria (three new). Half the sea anemone species are widely distributed: *Actinauge verrillii* McMurrich, 1893, *Actinoscyphia groendyki* n. sp., *Actinostola faeculenta* (McMurrich, 1893), *Bathyphellia australis* Dunn, 1983, *Liponema brevicorne* (McMurrich, 1893), *Metridium farcimen* (Brandt, 1835), and *Monactis vestita* (Gravier, 1918). The others are known only from the northeastern Pacific Ocean: *Corallimorphus pilatus* Fautin, White, and Pearson, 2002, *Corallimorphus denhartogi* Fautin, White, and Pearson, 2002, *Anthosactis nomados* White, Wakefield Pagels, and Fautin, 1999, *Bolocera kensmithi* n. sp., *Paraphelliactis pabista* Dunn, 1982, *Sagartiogeton californicus* (Carlgren, 1940) (for which we designate a neotype), and *Sicyonis careyi* n. sp. A naturally occurring oxygen minimum zone (OMZ) off Oregon is expanding, and the marine life living within its virtually anoxic areas is threatened. Nine of the species we examined occur within the current depth range of the OMZ and may be threatened if the OMZ continues to strengthen and expand.

Key words: Biogeography, Coelenterata, Hexacorallia, Bathyal, Abyssal

Introduction

Animals belonging to cnidarian orders Actiniaria and Corallimorpharia (sea anemones *sensu lato*) in deep waters of the northeastern Pacific Ocean are poorly known. By contrast, the intertidal and shallow subtidal fauna of the area has been well studied; about 30 species have been documented in shallow habitats (e.g. Gotshall 1994; Fautin & Hand 2007). We used morphological characters to identify specimens previously collected on the continental slope and abyssal plain. We estimate, based on the literature and the four largest museum collections of these animals, that about 35 species of anemones occur from southern California to northern British Columbia at 1,000 m and deeper. We provide an inventory of the 14 largest and most abundant epibenthic species: 12 actiniarians, three of which we describe as new species, and two corallimorpharians. In addition, as part of our consideration of *Sicyonis*, we move from that genus the species now properly known as *Parasicyonis biotrans* (Riemann-Zürneck, 1991).

Aside from contributing to basic knowledge of marine biodiversity (Cressey 2010), this inventory may be useful in assessing the impact of the oxygen minimum zone (OMZ) off the coast of Oregon that is expanding in space and time (Chan *et al.* 2008; Gewin 2010). Because many of the specimens on which it is based were collected in the 1970s and 1980s, before the expansion of the OMZ, this inventory of the anemones of the deep northeastern Pacific Ocean can be used as a baseline for comparison in future biotic inventories in the OMZ to determine if expansion of the OMZ has affected sea anemones.

Ekman (1953) reported that many deep-sea taxa are widely distributed. Vinogradova (1959) refined that generalization by considering taxonomic rank; she discovered in an analysis of 1,031 species from around the world at deeper than 2,000 m that at the generic level faunas are similar, but endemicity is high at the species level. Similarly, Rodríguez *et al.* (2007) found that all 31 families of anemones in the Southern Ocean (including the Sub-Antarctic [Deacon 1982; Rodríguez *et al.* 2007]), as well as 75% of the genera, have representatives elsewhere in the world, but 75% of the species are endemic. The wide distribution of higher taxa in the deep sea is likely due to connectivity of the waters due to thermohaline circulation, termed by Broecker (1991) the great ocean conveyor.

We found that all families, as well as 92% of the genera (all except *Paraphelliactis* Carlgren, 1928b), have representatives outside the Pacific Ocean, but that 71% of the species are endemic to the North Pacific. Of the new species of Actiniaria we identified, *Bolocera kensmithi* n. sp. and *Sicyonis careyi* n. sp. are known only from the northeastern Pacific Ocean, and *Actinoscyphia groendyki* n. sp. is found in both the North Pacific and Southern Oceans. In addition to the northeastern Pacific, *Actinauge verrillii* McMurrich, 1893, and *Bathyphellia australis* Dunn, 1983, have been recorded in the Southern Ocean, and *Monactis vestita* (Gravier, 1918) has been recorded in the Atlantic. The remaining species are known only from the North Pacific. Three occur on both the east and west sides of that ocean basin: *Actinostola faeculenta* (McMurrich, 1893), *Liponema brevicorne* (McMurrich, 1893), and *Metridium farcimen* (Brandt, 1835). All others are endemic to the northeastern Pacific Ocean: *Corallimorphus denhartogi* Fautin, White, and Pearson, 2002*, Corallimorphus pilatus* Fautin, White, and Pearson, 2002*,*

Anthosactis nomados White, Wakefield Pagels, and Fautin, 1999*, Paraphelliactis pabista* Dunn, 1982, and *Sagartiogeton californicus* (Carlgren, 1940).

Materials and methods

We examined 8,226 specimens in 934 lots representing 14 species. Most specimens were collected by beam and otter trawls in the northeastern Pacific Ocean from southern California to British Columbia to a depth of 4,325 m. Many were collected during studies off the coast of Oregon in the 1960s and 1970s by Andrew G. Carey, Jr. of Oregon State University (e.g. McCauley & Carey 1967; Carney & Carey 1982), and approximately 200 km off the coast of southern California at Station M (Smith *et al.* 1994) in the 1990s by Kenneth L. Smith, Jr., then of Scripps Institution of Oceanography (now at the Monterey Bay Aquarium Research Institute, Moss Landing, California [MBARI]). Most of Carey's specimens are held at the Santa Barbara Museum of Natural History, Santa Barbara, California, USA (SBMNH), and Smith's are in the Division of Invertebrate Zoology of the University of Kansas Biodiversity Institute, Lawrence, Kansas, USA (KUIZ). Specimens collected by the Department of Fisheries and Oceans of Canada (DFO) from the 1970s through the early 21st century were examined at the Royal British Columbia Museum, Victoria, British Columbia, Canada (RBCM) and California Academy of Sciences, San Francisco, California, USA (CAS). We examined other relevant specimens in these museums, and a syntype of *Actinauge verrillii* from the US National Museum of Natural History, Washington, DC, USA (USNM).

Histological sections were prepared by embedding specimens in Paraplast®, sectioning at 8–12 µm, and staining with hematoxylin and eosin (Humason 1967).

Undischarged cnidae were measured from squash preparations of tissue from tentacles, column, actinopharynx, acontia, and mesenterial filaments at 1,000x using a compound light microscope equipped with differential interference contrast (Nomarski) optics. Cnidae were not measured from the column of animals that were devoid of ectoderm, a state common in deep-sea anemones (Carlgren 1956; Fautin & Hessler 1989; Riemann-Zürneck 1994; White *et al.* 1999). Nematocyst identification was based on Fautin (1984), and the terms robust and gracile are used to describe two morphologically distinct types of spirocysts (Arellano & Fautin 2001). In tables displaying nematocyst measurements, "N" represents the fraction of animals examined that contained a particular type of cnida, and "n" represents the total number of capsules measured. Letters refer to image of the corresponding cnida in the cited figure.

We provide complete taxonomic descriptions for the new species, and similar information for *Sagartiogeton californicus*, the original description of which was excessively short. We briefly discuss the other species and add information on their distributions, based on specimens examined. A dichotomous key to the deep northeastern Pacific anemones is based on our research; a dichotomous key distinguishing each new species we describe from its congeners is based on published descriptions and redescriptions for the species that we did not examine. Species treatments of members of order Corallimorpharia are first. Families are alphabetical in each order, as are genera in each family.

Appendices contain lists of specimens examined or cited from the literature. Abbreviations for museums holding specimens that we did not examine for this study are CMN (Canadian Museum of Nature, Ottawa, Ontario, Canada), LACM (Natural History Museum of Los Angeles County, Los Angeles, California, USA), MCZ (Harvard Museum of Comparative Zoology, Cambridge, Massachusetts, USA), MLML (Moss Landing Marine Laboratory, Moss Landing, California, USA), MOM (Musée Océanographique de Monaco, Monaco-Ville, Monaco), MZLU (Museum of Zoology, Lund University, Lund, Sweden), RMNH (Nationaal Natuurhistorisch Museum, Leiden, The Netherlands), SIO (Scripps Institution of Oceanography, La Jolla, California, USA), and YPM (Yale Peabody Museum of Natural History, New Haven, Connecticut, USA). Type status abbreviations are H (holotype), S (syntype[s]), P (paratype[s]), and N (neotype). Specimens are arranged geographically, south to north; descriptive localities, to the highest detail possible, are given for those lacking coordinates.

Distribution maps were created with ArcInfo using locality data from specimens examined and the literature. For specimens lacking coordinates, we used the georeferenced value for the named locality in the Hexacorallians of the World database (Fautin 2011), if present. If not, the locality is the centroid for the cruise on which the specimen was collected, or, if depth is known, an estimate from nautical charts (US National Oceanographic and Atmospheric Administration: NOAA) based on the depth at which the specimen was collected. On distribution

maps, localities of specimens of documented latitude, longitude, and depth data are represented as circles; estimated localities are represented as triangles. Solid symbols are new localities, and a previously published locality is an open symbol with a dot in the center. Depths are in meters: average depth is used if a depth range is provided, and depth is estimated from the ETOPO2 (2'[2]) bathymetry data set (National Geophysical Data Center 2006) for specimens lacking depth information.

Dichotomous key to sea anemones of the deep of northeastern Pacific

The following key is based on both external and internal morphology and can be used to identify some species from photos. Every effort was made to be sufficiently precise so that animals belonging to species other than the 14 included in this study will not be misidentified as one of the 14.

1	Each tentacle with acrosphere. Marginal sphincter muscle and siphonoglyphs absent	2
-	Tentacles lack acrospheres. Marginal sphincter muscle and siphonoglyphs present	3
2	Column discoidal. About 72 tentacles; marginal and discal tentacles in an approximate 2:1 ratio	*Corallimorphus denhartogi* (p. 7)
-	Column cylindrical. About 130 tentacles; marginal and discal tentacles occur in an approximate 4:1 ratio	*Corallimorphus pilatus* (p. 9)
3	Color pink to orange to tan in life and preservation. Tentacles deciduous; when tentacles are cast off, pore marks position of each. Marginal sphincter muscle endodermal	4
-	Tentacles not deciduous. Marginal sphincter muscle mesogleal	5
4	Column conspicuous, somewhat narrower than oral disc. About 48 tentacles arrayed along margin, one tentacle connecting with each exocoel	*Bolocera kensmithi* n. sp. (p. 10)
-	Column short, hidden beneath dome of oral disc, margin of which extends to level of column base. Several hundred tentacles cover oral disc that is much broader than column, more than one tentacle connecting with each exocoel	*Liponema brevicorne* (p. 40)
5	Column not divisible into two regions. Acontia absent	6
-	Column divisible into two regions (scapus and scapulus, or scapus and capitulum). Acontia present	9
6	Animal long; column mesoglea thick	7
-	Animal flat, attached to scaphopod shell. Column mesoglea thin	*Anthosactis nomados* (p. 21)
7	Tentacles cover at least half of oral disc. More than six pairs of mesenteries complete; members of young mesentery pairs not equally developed	8
-	Tentacles restricted to margin, thickened aborally at base. Six pairs of mesenteries complete; members of young mesentery pairs equally developed	*Actinoscyphia groendyki* n. sp. (p. 15)
8	Column bumpy; typically tapers from distal to proximal end. To more than 200 tentacles. Mesenteries most numerous distally	*Actinostola faeculenta* (p. 22)
-	Column smooth; typically cylindrical. About 80 tentacles. Mesenteries most numerous proximally	*Sicyonis careyi* n. sp. (p. 26)
9	Oral disc not lobed. Column divisible into scapus and scapulus	10
-	Oral disc lobed. Column smooth, divisible into scapus and capitulum. Acontia with microbasic *b*-mastigophores and microbasic amastigophores	*Metridium farcimen* (p. 41)
10	Scapus not smooth; with tubercles or tenaculi	11
-	Scapus smooth	13
11	Scapus of intact animal black, rough due to cuticle-covered tentaculi; very short scapulus orangish. Column cannot shorten. Pedal disc attached to manganese nodule. Acontia small, difficult to find	*Bathyphellia australis* (p. 31)
-	Scapus with tubercles. Acontia numerous and apparent	12
12	Tubercles pointed; arrayed in longitudinal rows. Tentacles more numerous than number of mesenteries at mid-column	*Paraphelliactis pabista* (p. 37)
-	Tubercles flat; not arrayed in longitudinal rows. Same number of tentacles as mesenteries along column	*Actinauge verrillii* (p. 34)
13	About 32 tentacles. Acontia with only basitrichs. Cinclides absent	*Monactis vestita* (p. 35)
-	About 200 tentacles. Acontia with basitrichs and microbasic amastigophores. Cinclides present	*Sagartiogeton californicus* (p. 43)

Order Corallimorpharia

Family Corallimorphidae Hertwig, 1882

Genus *Corallimorphus* Moseley, 1877

***Corallimorphus denhartogi* Fautin, White, and Pearson, 2002**
(Figures 1–2, Appendix 2)
No synonyms

Diagnosis. Column short and discoidal (Figure 1); oral disc to approximately 70 mm diameter; ectoderm sloughed off nearly all specimens. Mouth small (less than 1/3 oral disc diameter), ovoid; lips around mouth indistinct. Tentacles short and capitate, acrospheres typically broken off. Discal tentacles short, all about same size (2 mm long); marginal tentacles in three sizes (approximately 12 large, 12 medium, 24 small), to 8 mm long. Marginal:discal tentacles in approximately 2:1 ratio; about 72 total. Pedal disc slightly concave. For a detailed description of *C. denhartogi,* see Fautin *et al.* (2002).

Cnidae. Spirocysts, basitrichs, holotrichs, microbasic *p*-mastigophores, microbasic *b*-mastigophores.

Distribution. *Corallimorphus denhartogi* was originally described from California to Oregon at depths of 2,550 to 4,300 m (Fautin *et al.* 2002). All specimens we examined occur within the previously known range (Figure 2).

Material examined. See Appendix 2.

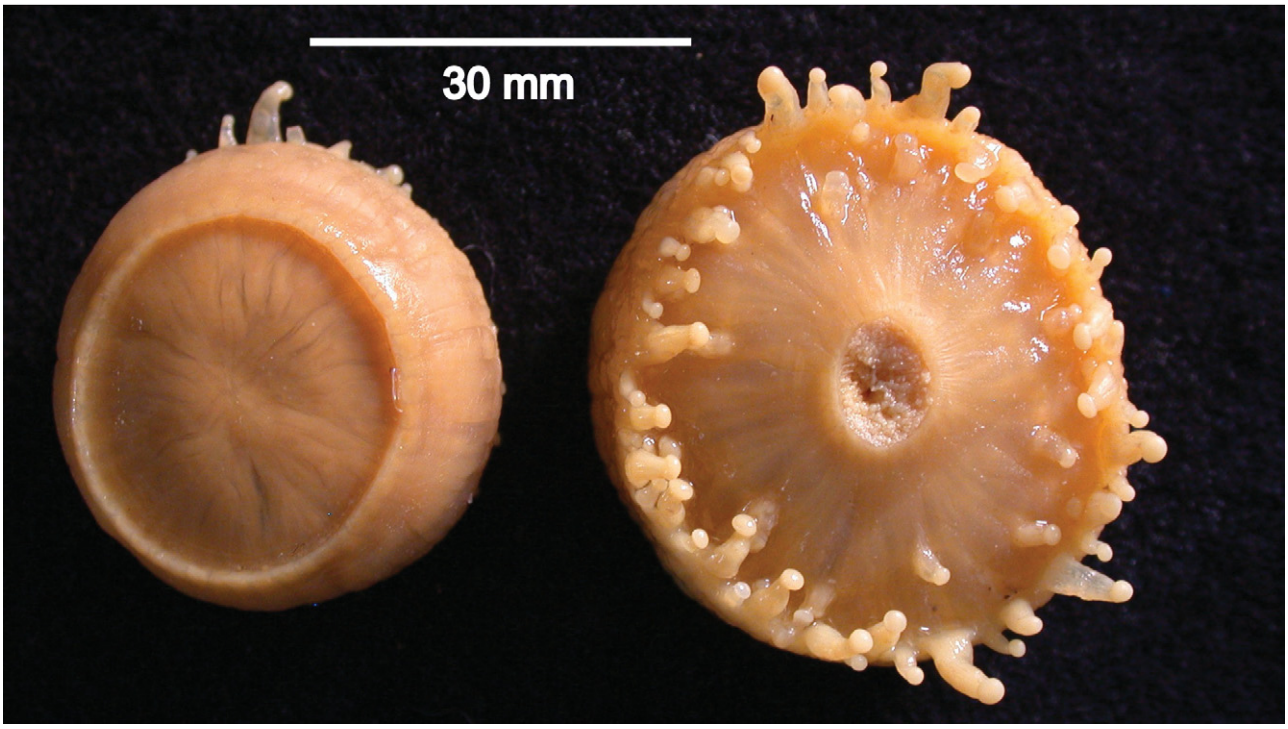

FIGURE 1. Specimens of *Corallimorphus denhartogi* (KUIZ 001554).

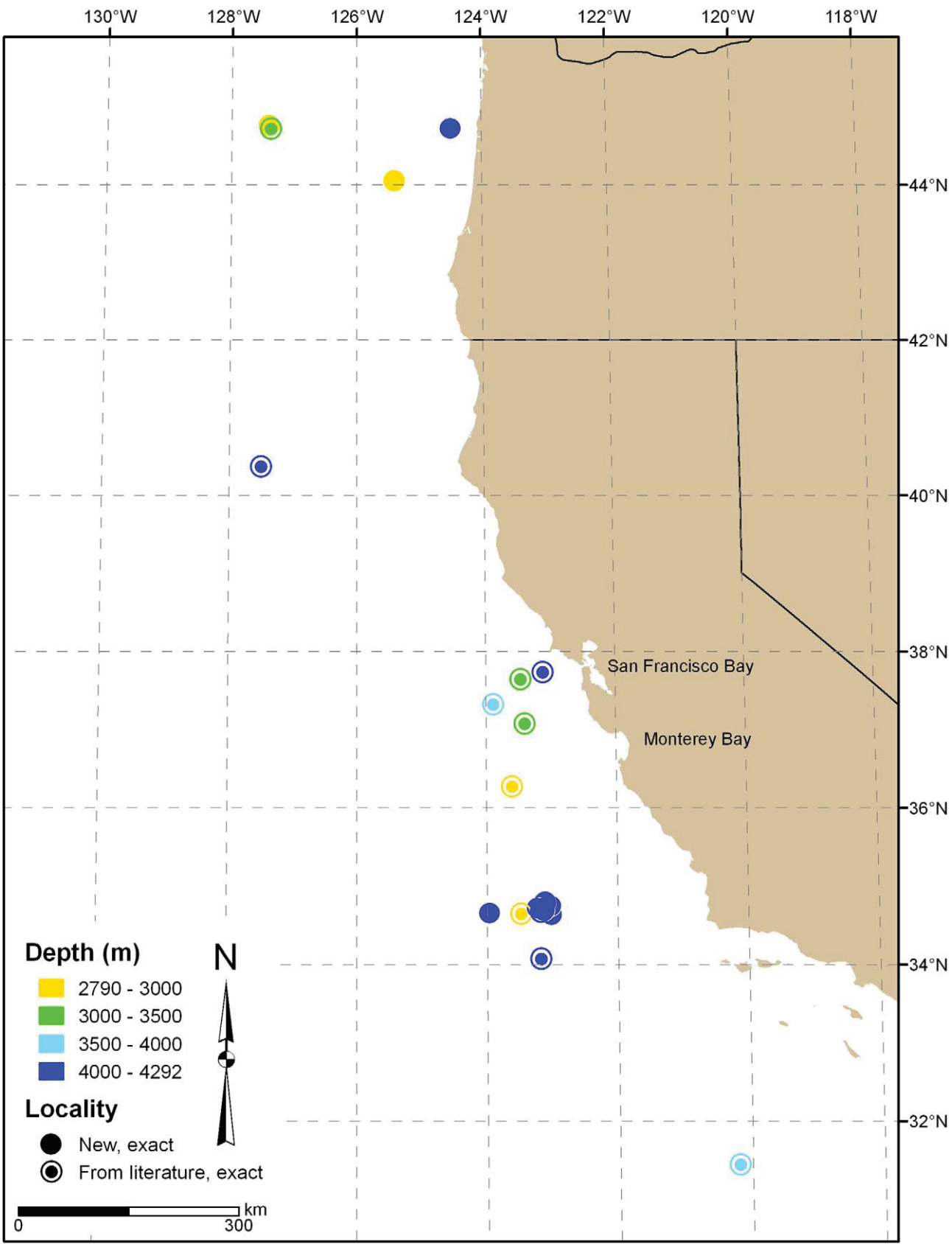

FIGURE 2. Distribution of *Corallimorphus denhartogi* from southern California to Oregon.

***Corallimorphus pilatus* Fautin, White, and Pearson, 2002**
(Figures 3–4, Appendix 3)
No synonyms

Diagnosis. Column cylindrical; oral and pedal discs about same diameter (to 35 mm), column slightly shorter than diameter of discs (to 20 mm). Sparse tan ectoderm may be attached to column; brown ectoderm may persist near base of tentacles. Oral disc with raised lips around slit mouth; with long, capitate tentacles (Figure 3). Marginal tentacles shorter than discal tentacles (about 15 mm), in approximately 4:1 marginal:discal ratio; about 130 total. Pedal disc typically attached to stone or shell. For a detailed description of *C. pilatus* see Fautin *et al.* (2002).

Cnidae. Spirocysts, basitrichs, holotrichs, microbasic *p*-mastigophores, microbasic *b*-mastigophores.

Distribution. *Corallimorphus pilatus* was originally described from California to British Columbia at depths of 198 to 900 m (Fautin *et al.* 2002). Additional specimens we examined extend the range north to include south coastal Alaska (Figure 4) and down to 2,026 m.

Material examined. See Appendix 3.

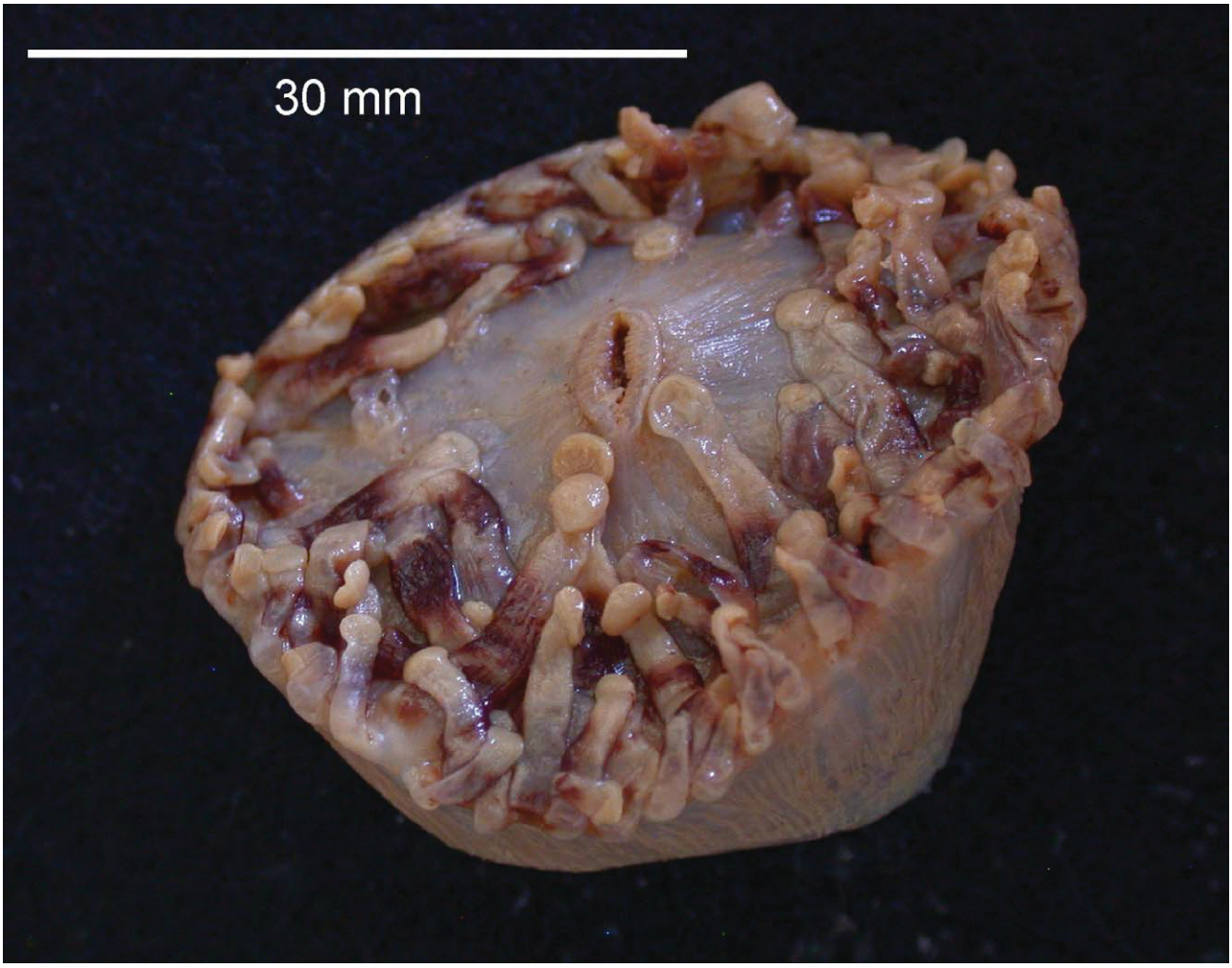

FIGURE 3. Specimen of *Corallimorphus pilatus* (KUIZ 003256).

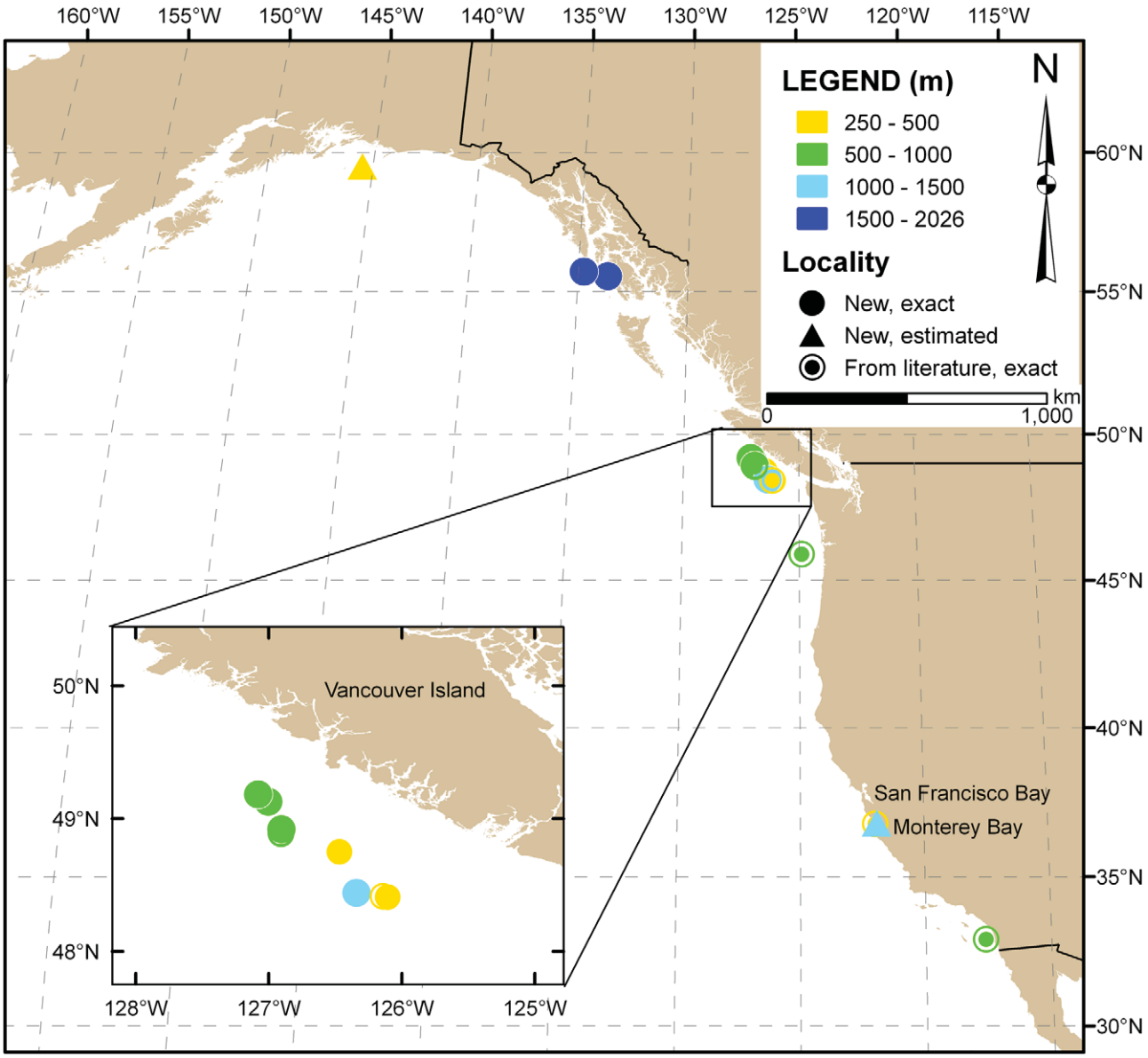

FIGURE 4. Distribution of *Corallimorphus pilatus* from California to the Gulf of Alaska.

Order Actiniaria

Family Actiniidae Rafinesque, 1815

Genus *Bolocera* Gosse, 1860

Bolocera kensmithi n. sp.

(Figures 5–8, Table 1, Appendix 4)

Body form and size. Column tan or pink, smooth, ectoderm typically slightly wrinkled. Column stiff but not thick (about 0.5 mm); mesenterial insertions typically visible along entire length, most evident at limbus and margin. In some preserved specimens mesenteries protrude from proximal end of column or pedal disc (Figure 5).

Most animals contracted so margin partially covers insertion of tentacles. Column short (10–31 mm long), in most animals tapers from oral disc (8–41 mm diameter) to pedal disc (3–22 mm diameter); one specimen inside-out so mesenteries were exposed (Figure 5).

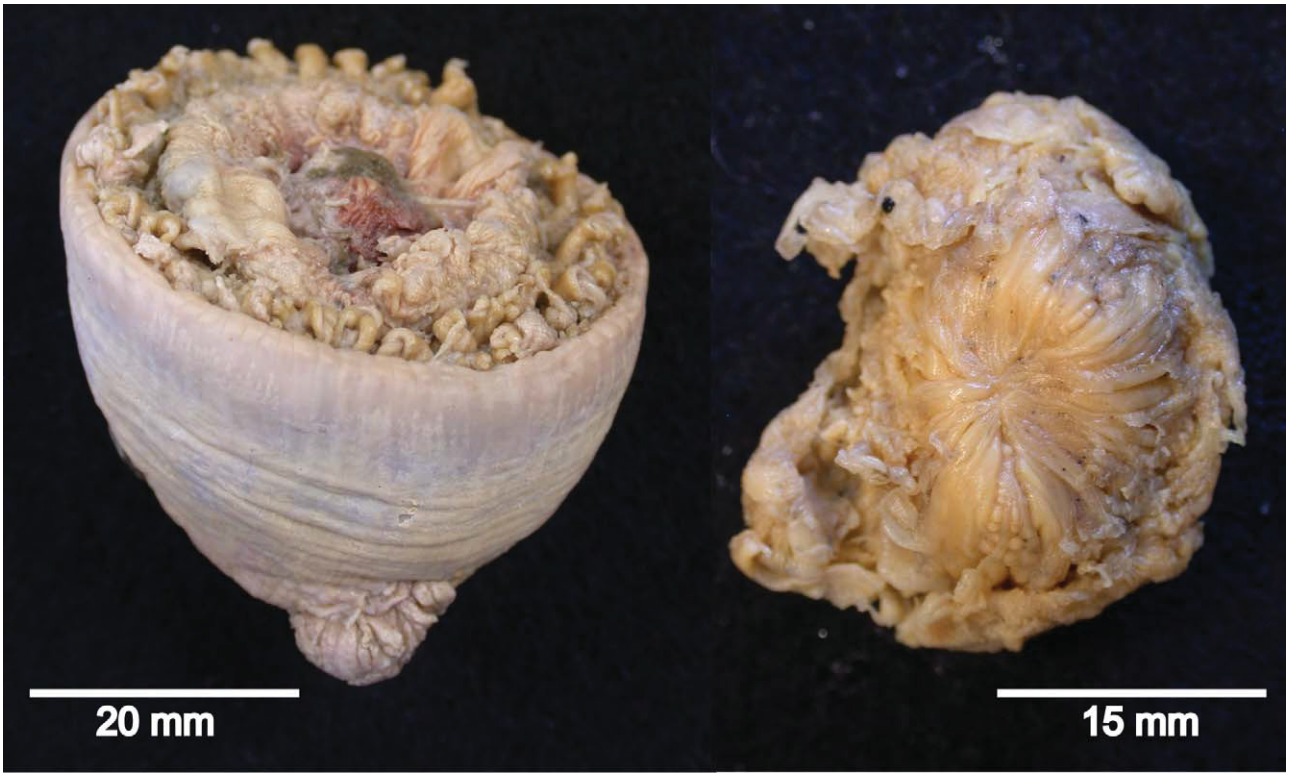

FIGURE 5. Specimens of *Bolocera kensmithi* n. sp. Holotype specimen lacking tentacles on left (KUIZ 003252); specimen lacking tentacles and turned inside-out on right (KUIZ 001518).

Tentacles deciduous (characteristic of genus): circumscribed endodermal sphincter muscle at base of each tentacle. All specimens devoid of tentacles.

Pedal disc. Tan to pink, wrinkled or smooth. Circular, slightly concave; about half diameter of oral disc.

Oral disc and tentacles. Oral disc tan to reddish-purple; smooth in poorly-preserved specimens, radially furrowed along mesenterial insertions in well-preserved specimens. In most specimens, oral disc torn, and mesenteries protrude through mouth. Mouth large (about 2/3 diameter of oral disc, opening to 18 mm); radially furrowed, lips raised and very prominent when mouth not torn (to 5 mm wide and long). Two prominent, symmetrical, off-white siphonoglyphs apparent in specimens with intact oral disc.

Number and arrangement of tentacles inferred by pores (to about 2 mm diameter) on oral disc; small ridge typically surrounds each pore. To 72 pores, about 48 in most specimens, arrayed in three or four cycles; those of inner cycles communicate with endocoels, those of outermost cycle communicate with exocoels.

Internal anatomy. Actinopharynx tan to deep purple, longitudinally furrowed; protruded in most specimens, nearly same length as column. Each of two long symmetrical siphonoglyphs attached to pair of directive mesenteries.

Mesenteries thick and muscular, hexamerously arrayed in three cycles; typically more numerous at limbus than at margin (e.g. 56 vs. 48). Rare quaternary mesenteries occur in pairs between mesenteries of second and third cycles (i.e. 11**44**33442244334**44**11: bolded 4s represent position of quaternary mesenteries absent in most specimens examined). First to third cycle complete; youngest complete mesenteries reach actinopharynx only at distal end. Incomplete mesenteries lack filaments. Oral stomata large, marginal stomata small. Directives and some members of youngest cycle sterile; all other mesenteries fertile. Sexes separate; ova to about 1.5 mm diameter.
Retractor muscles strong and diffuse (Figure 6a); in some specimens may be lobed. Parietobasilar muscles with no pennons or short detached ones.

Diffuse endodermal marginal sphincter muscle poorly developed; lamellae short to moderately long (Figure 6b).

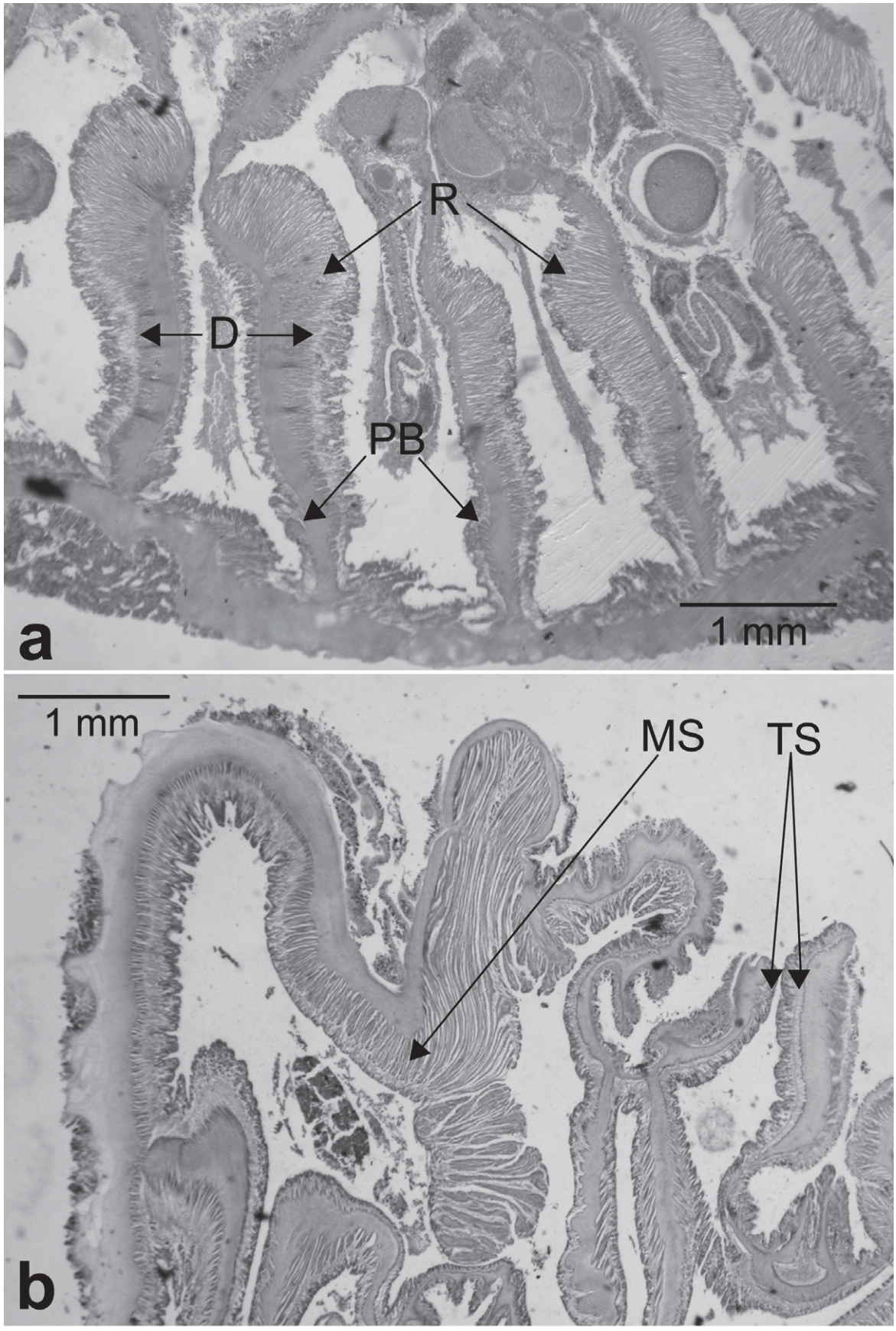

FIGURE 6. *Bolocera kensmithi* n. sp. a. Cross section with directive mesenteries (D), diffuse retractor muscles (R), and parietobasilar muscles (PB); b. Longitudinal section with endodermal marginal sphincter muscle (MS) and endodermal tentacle sphincter muscle (TS).

Cnidae. Basitrichs, microbasic *p*-mastigophores; presumably spirocysts are present in tentacles, but all specimens examined lacked tentacles. Sizes and distribution of cnidae given in Table 1; cnidae illustrated in Figure 7.

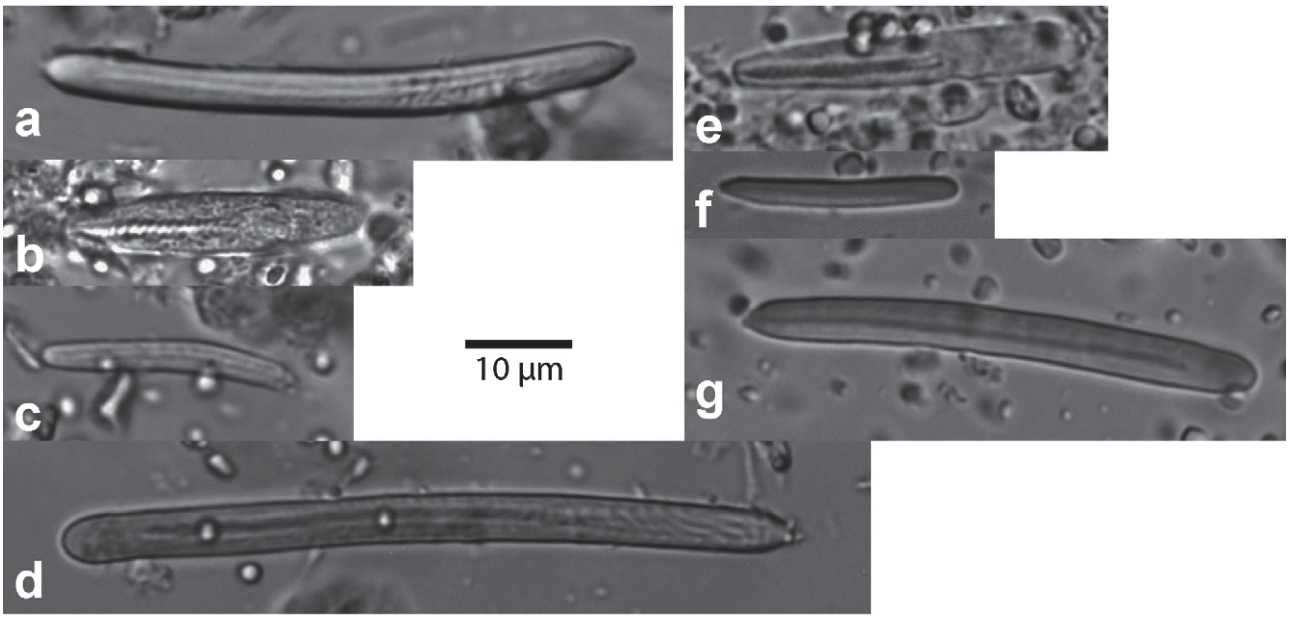

FIGURE 7. Cnidae of *Bolocera kensmithi* n. sp.; distribution and dimensions in Table 1. a. Basitrich; b. microbasic *p*-mastigophore; c. basitrich; d. basitrich; e. microbasic *p*-mastigophore; f. basitrich; g. basitrich.

TABLE 1. Cnidae size and distribution of *Bolocera kensmithi* n. sp. All specimens lacked tentacles. * Sparse.

Tissue and Cnida Type	Length x Width (µm)	n	N
Actinopharynx			
Basitrichs (a)	(49.0) 54.1–75.7 x 4.0–5.1	36	5/5
Microbasic *p*-mastigophores* (b)	25.2–31.4 x 4.6–5.6 (6.0)	13	3/5
Mesenterial Filaments			
Basitrichs* (c)	21.2–28.7 (35.4) x 2.6–3.3	38	6/6
Basitrichs (d)	(57.1) 59.1–74.1 x 3.9–5.2	49	6/6
Microbasic *p*-mastigophores* (e)	(25.4) 26.9–36.2 (37.7) x 4.0–5.4 (5.9)	48	6/6
Column			
Basitrichs (f)	(18.0) 19.8–26.9 (29.0) x 2.3–3.2	30	5/5
Basitrichs (g)	36.1–50.8 (53.1) x 3.5–4.9	41	5/5

Type specimens. Holotype: KUIZ 003252, collected 6-Apr-2003 from 49.35–49.33° N 127.55–127.52° W, 1,804–1,827 m. Column length 25 mm, oral disc diameter 40 mm, and pedal disc 22 mm. Third cycle of mesenteries developed, fourth cycle partially developed with same number of tentacle pores.

Paratypes: CAS 184529, 4 specimens collected 5-Jun-1996 from 34.67° N 123.18° W, 4,100 m; USNM 1149361, 1 specimen collected 14-Nov-1995 from 34.70° N 123.03° W, 4,100 m; KUIZ 001522, 1 specimen collected 29-Jan-1996 from 34.72° N 123.22° W, 4,100 m; SBMNH 149659, 1 specimen collected 17-Oct-1992 from 34.77° N 123.13° W, 4,100 m; RBCM 010-00573-001, 1 specimen collected 15-Apr-2003 from 49.71–49.71° N 127.95–127.96° W, 2,003–2,091 m.

Etymology. Named in honor of Kenneth L. Smith, Jr., who collected specimens of this species, as well as many other deep-sea anemones, from Station M off the coast of California.

Distribution. *Bolocera kensmithi* n. sp. lives in the northeastern Pacific Ocean, and has been collected in trawls from at least 1,804 m to 4,100 m (Figure 8).

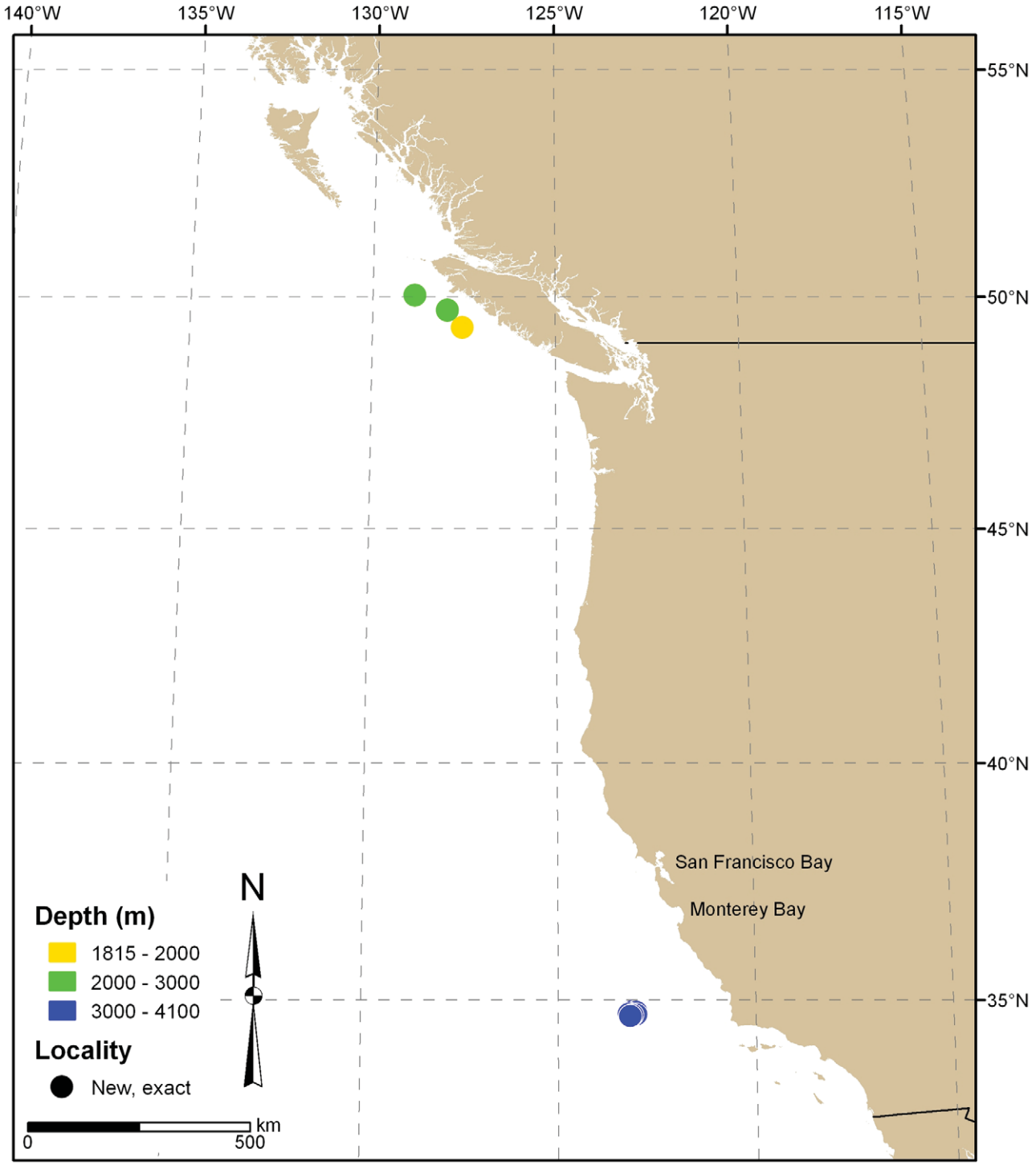

FIGURE 8. Distribution of *Bolocera kensmithi* n. sp. from California to British Columbia.

Material examined. See Appendix 4.

Differential diagnosis. The only other species of *Bolocera* known from the northeastern Pacific is *B. pannosa* McMurrich, 1893, which has a large, convex oral disc covered by about 400 tentacles, and an oral disc that conceals the short column, is easily separated from *B. kensmithi* n. sp. *Bolocera kensmithi* n. sp. can be distinguished from its congeners by its combination of: concave pedal disc; column that tapers from the widest part distally to the narrowest part proximally; about 48 tentacles arrayed in four cycles; 24 pairs of mesenteries arrayed in three cycles (plus occasionally a few pairs of a fourth cycle); directive mesenteries sterile; marginal stomata.

Dichotomous key to species of *Bolocera* (except *Bolocera maxima*, described by Carlgren [1921] from off Greenland based solely on tentacles, and therefore distinguished by its nematocysts, for which we lack comparable data for *B. kensmithi* n. sp.).

1 Column so short margin almost touches limbus, oral disc broad and convex 2
- Column not short, either cylindrical or wider at distal than at proximal end, margin not near limbus 3
2 About 400 flaccid slender tentacles to 37 mm long arrayed in seven cycles. Pedal disc oval (70 x 25 mm diameter in average specimen) and thin; mesenterial insertions visible. Northeastern Pacific Ocean . . . . . *B. pannosa* McMurrich, 1893
- About 150 blunt digitiform tentacles to 20 mm long scattered over oral disc. To five cycles of mesenteries; oral and marginal stomata present. Pedal disc circular, slightly larger diameter than proximal end of column. Two size classes of basitrichs in actinopharynx. Southern Ocean . . . . . *B. paucicornis* Dunn, 1983
3 Marginal sphincter muscle well developed 4
- Marginal sphincter muscle poorly developed 5
4 Column approximately twice as long as diameter of oral and pedal disc in preserved specimens; tentacles arrayed in four cycles. Off East Africa . . . . . *B. africana* Pax, 1909
- Column thin, same length as diameter of oral disc in preservation. About 200 long, conical, and longitudinally furrowed tentacles arrayed in five or six cycles. Northern Atlantic Ocean . . . . . *B. tuediae* (Johnston, 1832)
5 All mesenteries fertile except for directives and some of youngest cycle 6
- Mesenteries of first cycle, and some of second cycle sterile; 96 pairs of mesenteries total, 48 pairs complete. About 180 tentacles. Off East Africa . . . . . *B. somaliensis* Carlgren, 1928a
6 Mesenteries lack oral and marginal stomata. To five cycles of thin mesenteries equally developed along column; parietobasilar muscles with large detached pennons. Tentacles (to about 100) arrayed in as many as seven cycles. Basitrichs of mesenterial filaments to 64 µm long, one size class of basitrichs in column. South of 30° S . . . . . *B. kerguelensis* Studer, 1879
- Mesenteries possess oral and marginal stomata. 24 pairs of thick mesenteries arrayed in three cycles (plus rarely a few pairs of a fourth cycle), develop from proximal end; parietobasilar muscles with small detached pennons or without pennons. About 48 tentacle pores (correspond to number of tentacles in life) arrayed in four cycles near margin. Pedal disc circular. Basitrichs of mesenterial filaments to 73 µm long; two size classes of basitrichs in column. Northeastern Pacific Ocean . . . . . *B. kensmithi* n. sp.

Family Actinoscyphiidae Stephenson, 1920

Genus *Actinoscyphia* Stephenson, 1920

Actinoscyphia groendyki n. sp.

(Figures 9–12, Table 2, Appendix 5)

Body form and size. Exposed mesoglea of specimens light grey to tan; some with dingy grey ectoderm sloughing off. Mesoglea thick throughout column, to 8 mm at proximal end of specimen 33 mm long. Column smooth and stiff; tapers from distal end. Margin contracted so column covers most tentacles. Oral disc in nearly all specimens examined folded in half perpendicular to long axis, giving animals Venus flytrap posture (Figure 9). Pedal disc elongate; long axis in same direction as long axis of oral disc.

Column 9–42 mm long; long axis of pedal disc approximately same length as long axis of oral disc, typically longer than column.

Pedal disc. Pedal disc tan or light brown; most specimens with metallic brown chitinous material, inferred to be secreted by animal, closely associated with pedal disc. Most elongate, from 4 to 134 mm; in large specimens pedal disc wrapped around or appears to have been wrapped around cylindrical object such as worm tube or group of sponge spicules (Figure 9). In small specimens (about 10 mm column length) pedal disc small, concave, holds bolus of mud.

Oral disc and tentacles. Oral disc tan or salmon, oval, radially furrowed along mesenterial insertion; folds in half, hiding tentacles.

Mouth circular, approximately 1/4 oral disc diameter; with raised lips. Slightly darker than oral disc, or deep purple; tan or light brown radial stripe typically at oral end of each siphonoglyph.

Tentacles slightly lighter in color than oral disc, smooth; tapered (1–4 mm at widest part of base to 0.1–1 mm at tip), 1–12 mm long, all thickened aborally with mesoglea. Most specimens with 120–149 tentacles (one small specimen possessed only 90) arrayed in two cycles near margin; exocoelic tentacles short and outermost, endocoelic tentacles long and innermost.

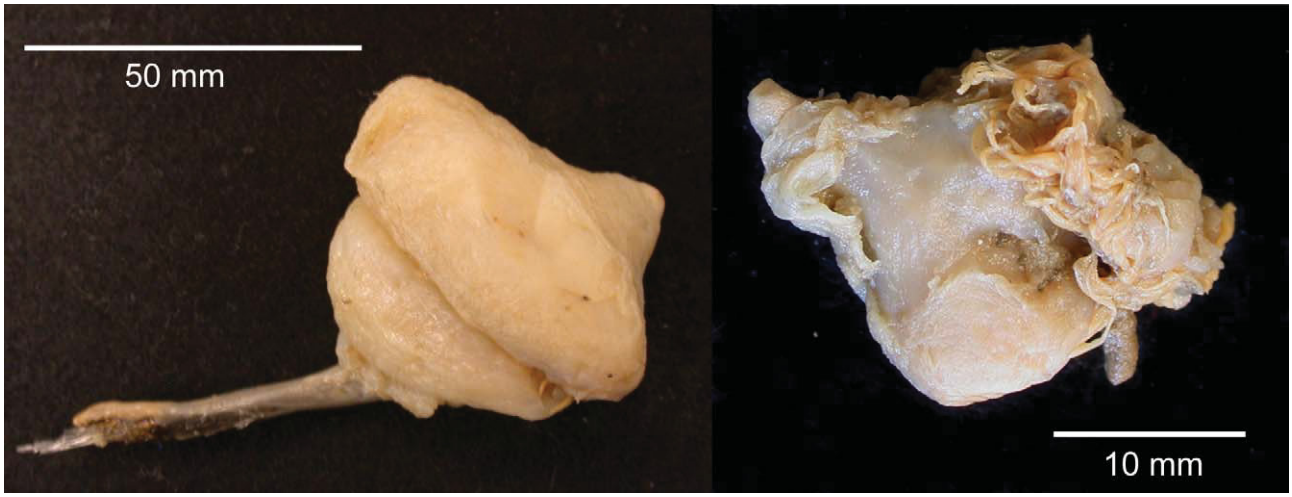

FIGURE 9. Specimens of *Actinoscyphia groendyki* n. sp. Specimen attached to sponge spicules on left (SBMNH 522590); specimen with tentacles visible on right (SBMNH 144408).

Internal anatomy. Actinopharynx deep purple, very long, longitudinally sulcate. Each of two symmetrical siphonoglyphs attached to pair of directive mesenteries; directive plane perpendicular to long axis of oral and pedal discs.

Mesenteries thin, typically arrayed in five cycles (specimens about 10 mm column length possess only four cycles); develop distally. All mesenteries with filaments; those of only first cycle complete, stomata absent. Mesenteries of first cycle sterile; mesenteries of second cycle rarely fertile; all younger mesenteries may be fertile. Mesenteries of youngest cycle regularly arrayed; all pairs do not develop simultaneously: one pair flanking a pair of preceding cycle develops on side nearer older pair of mesenteries (i.e. 11554**55**33**55**445522, bolded 5s represent where late-developing pairs will presumably appear, although absent in specimens examined) (Figure 10a). Pattern holds for fourth cycle mesenteries; in one specimen both pairs flanked those of third cycle in some places, and only one pair had developed in others. Retractor muscles very weak and short; parietobasilar muscles weak.

Mesogleal marginal sphincter muscle weak, moderately long (to approximately 1/3 column length), with many alveoli, slightly striated transversely in some specimens (Figure 10b), or distinctively striated only near proximal end. Situated in middle of mesoglea distally where broadest, occupies approximately half mesoglea width; tapers and approaches endoderm proximally. Alveoli pigmented, giving sphincter muscle tan color. Distal alveoli small and may be spaced apart or clumped; proximal alveoli larger.

Longitudinal muscles of tentacles mostly ectodermal with little mesogleal involvement, circular muscles endodermal (Figure 10c).

Cnidae. Gracile and robust spirocysts, basitrichs, holotrichs, microbasic *p*-mastigophores. Sizes and distribution of cnidae given in Table 2; cnidae illustrated in Figure 11.

Type specimens. Holotype: SBMNH 149661, collected 19-Feb-1971 from 44.99° N 126.66° W, 2,770 m. Column length 34 mm, oral disc folded 30 x 45 mm, and elongate pedal disc 40 mm. Fourth cycle of mesenteries developed, fifth cycle partially developed; 149 tentacles.

Paratypes: SBMNH 149662, 1 specimen, collected 19-Feb-1971 from 44.99° N 126.66° W, 2,770 m; KUIZ 003350, 1 specimen, collected 19-Feb-1971 from 44.99° N 126.66° W, 2,770 m; KUIZ 003351, 1 specimen, collected 18-Feb-1971 from 45.29° N 126.47° W, 2,710 m; USNM 1149362, 1 specimen, collected 18-Feb-1971 from 45.29° N 126.47° W, 2,710 m; CAS 184531, 1 specimen, collected 18-Feb-1971 from 45.29° N 126.47° W, 2,710 m; RBCM 010-00571-001, 1 specimen, collected 18-Feb-1971 from 45.29° N 126.47° W, 2,710 m.

Etymology. Named in honor of Eash-Loucks' late grandfather, James Groendyk.

Distribution. *Actinoscyphia groendyki* n. sp. occurs in both the Southern and northeastern Pacific oceans and has been collected from depths of at least 636 to 3,819 m (Figure 12).

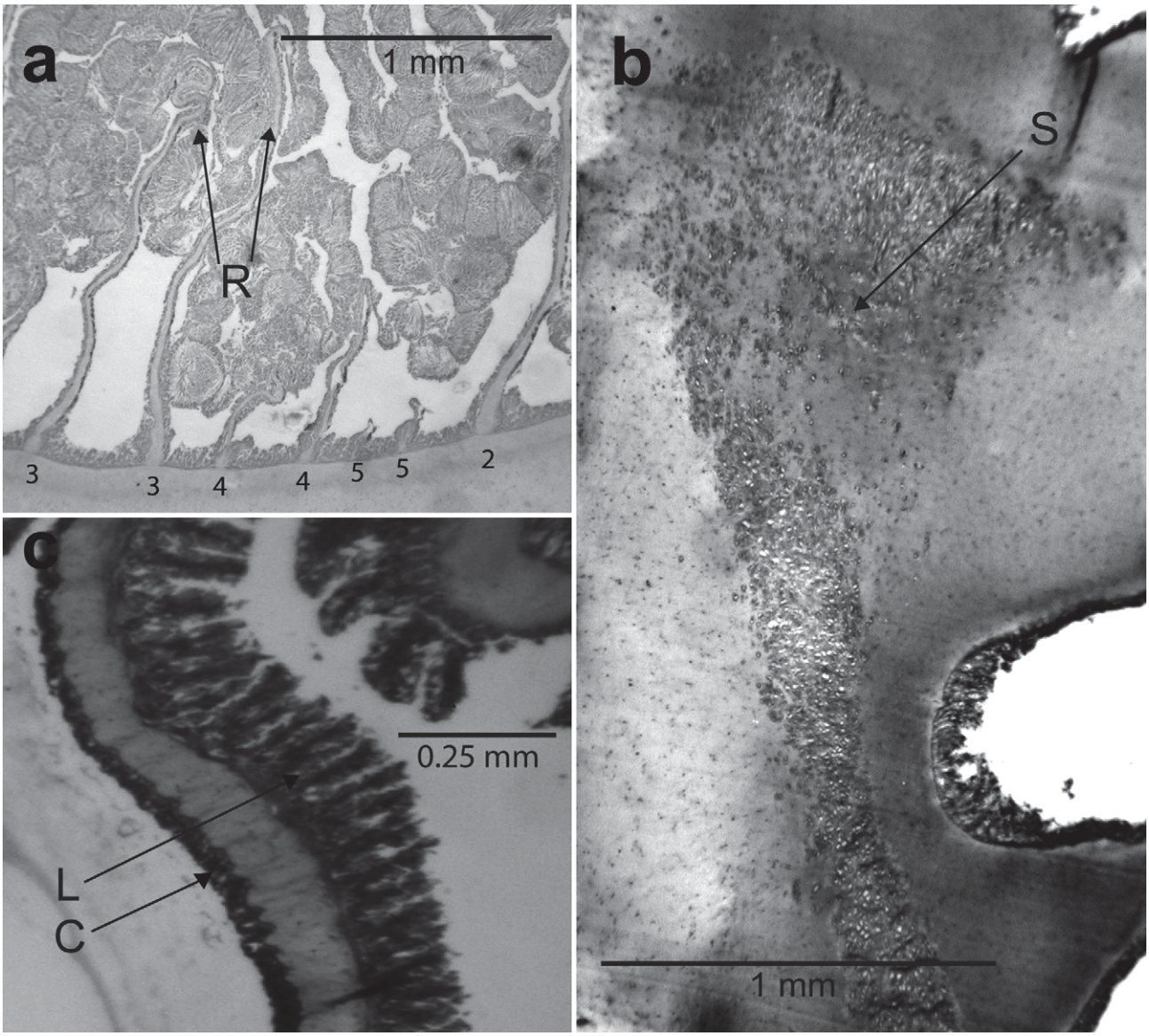

FIGURE 10. *Actinoscyphia groendyki* n. sp. a. Mesenteries of cycles 2–5 with diffuse retractor muscles (R); b. distal portion of mesogleal sphincter muscle (for illustration of variation of sphincter muscles see Fautin [1984]) (S); c. cross section of tentacle with endodermal circular musculature (C) and ectodermal longitudinal musculature with little mesogleal involvement (L).

Taxonomic remarks. We re-examined some of the 18 specimens from the Southern Ocean that Fautin (1984) had identified as *Actinoscyphia plebeia* (McMurrich, 1893). Features of specimens from the northeastern Pacific conform to what she reported except that 1) the microbasic *p*-mastigophores of the actinopharynx and the large basitrichs of the mesenterial filaments are smaller, and 2) mesenteries of the first cycle are always sterile whereas Fautin reported that only the directives and some mesenteries of the youngest cycle are sterile.

In the actinopharynx of specimens Fautin (1984) examined, we found small microbasic *p*-mastigophores (the smallest was 26.1 x 4.0 μm), which fall within the same size range as those of specimens of *A. groendyki* n. sp. Therefore, the only difference we found between specimens from the northeastern Pacific and Southern oceans was the size of large basitrichs in the mesenterial filaments, whose lengths overlaps by 1 μm. However, these nematocysts were not found in all specimens from the Southern Ocean, so they may be contaminants from the actinopharynx. We conclude that the specimens from the northeastern Pacific, as well as those examined by Fautin (1984), constitute a single species. In specimens from both localities, all mesenteries of the first cycle were sterile, as were those of the second cycle in most specimens. Thus these specimens clearly fall within the original diagnosis of *Actinoscyphia* by Stephenson (1920), which includes the first cycle of mesenteries being complete and sterile.

Some features of the specimens we examined from the northeastern Pacific and those identified by Fautin (1984) as *A. plebeia* differ from those of *Actinoscyphia plebeia* as originally described by McMurrich (1893); therefore, we also examined the holotype of *A. plebeia* (USNM 17789).

USNM 17789 has 235 tentacles (a small portion of the margin, about 1/15, including tentacles was removed). However, McMurrich (1893) described the species as having only 96 tentacles. The number of tentacles we observed corresponds to the number of mesenteries in the specimen, because the fifth cycle was fully developed and some members of the sixth cycle of mesenteries were observed.

The number of tentacles and mesenteries of the holotype of *A. plebeia* distinguish that species from the northeastern Pacific specimens of *Actinoscyphia* and those reported by Fautin (1984). Additionally, the new species is distinguished from *A. plebeia* by the length and shape of the sphincter muscle (short and distinctly transversely striated throughout its entire length in *A. plebeia*), thickness of the mesoglea (much thinner in *A. plebeia*), oral stomata in *A. plebeia*, and cnidae (most notably the lack of holotrichs in the tentacles of *A. plebeia,* although this may be due to the condition of the specimen) (Table 2) (see Dichotomous key of *Actinoscyphia*).

Because *Actinoscyphia groendyki* n. sp. occurs in both the Southern and northeastern Pacific Oceans, we consider it likely that *Actinoscyphia groendyki* n. sp. occurs in the Southeastern Pacific Ocean as well. This also means that the analysis of Rodríguez *et al.* (2007) for *A. plebeia* must be reconsidered.

Material examined. See Appendix 5.

Differential diagnosis. *Actinoscyphia groendyki* n. sp. can be distinguished from its congeners by its combination of: elongate pedal disc; oval oral disc; to about 150 tentacles that are thickened aborally; five cycles of mesenteries (to 144 mesenteries at limbus), of which six pairs are complete and the first and typically the second cycle are sterile; absence of stomata; moderately long mesogleal marginal sphincter muscle with pigmented alveoli.

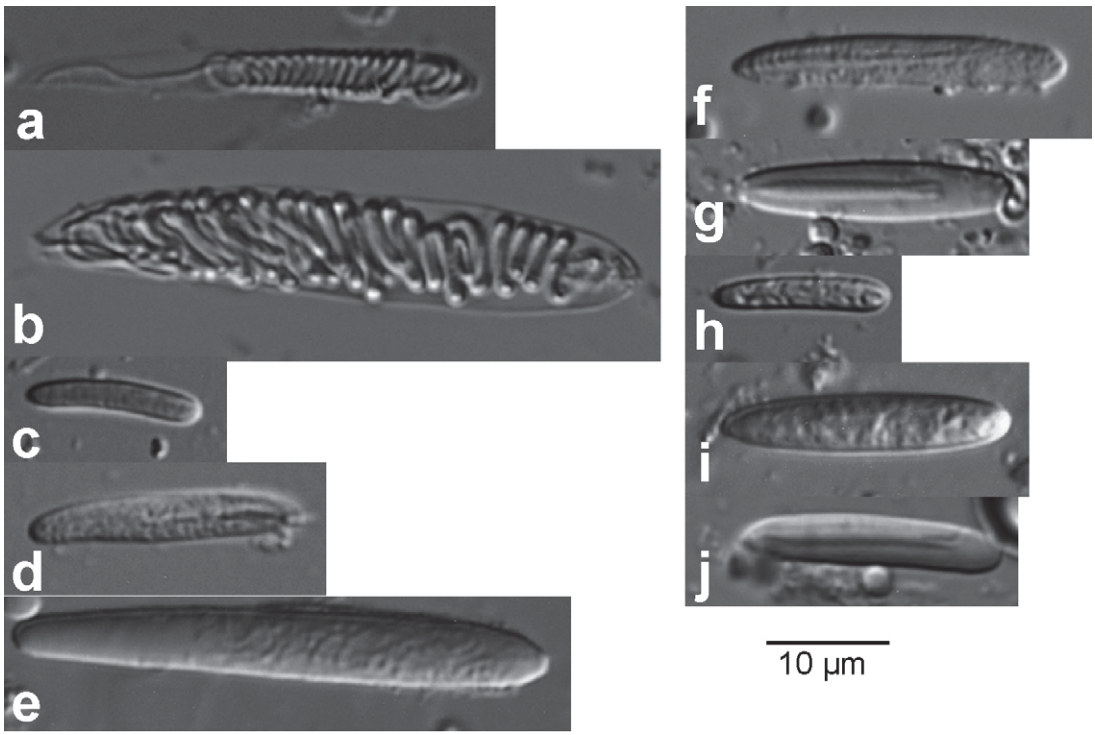

FIGURE 11. Cnidae of *Actinoscyphia groendyki* n. sp.; distribution and dimensions in Table 2. a. Gracile spirocyst; b. robust spirocyst; c. basitrich; d. basitrich; e. holotrich; f. basitrich; g. microbasic *p*-mastigophore; h. basitrich; i. basitrich; j. microbasic *p*-mastigophore.

TABLE 2. Cnida size and distribution of *Actinoscyphia groendyki* n. sp. and holotype of *Actinoscyphia plebeia* (USNM 17789). Microbasic *p*-mastigophores are sparse in the actinopharynx of *A. groendyki* n. sp.; therefore, it is possible we missed them in the holotype of *A. plebeia* because only one specimen was examined. * Sparse.

***Actinoscyphia groendyki* n. sp.**				***Actinoscyphia plebeia* (holotype)**			
Tissue and Cnida Type	**Length x Width (µm)**	**n**	**N**	**Tissue and Cnida Type**	**Length x Width (µm)**	**n**	**N**
Tentacles				**Tentacles**			
Gracile spirocysts (a)	21.5–42.5 (46.3) x 3.2–5.2 (5.6)	45	4/4	Spirocysts	23.9–48.9 x 3.4–5.7 (6.8)	10	1/1
Robust spirocysts (b)	25.6–64.4 x 4.2–11.3 (12.2)	51	4/4	Spirocysts	(31.2) 39.3–51.1 x 6.2–8.2	11	1/1
Basitrichs (c)	12.0–15.8 (20.6) x 2.0–3.0	35	4/4	Basitrichs	11.9–14.4 x 1.9–2.3	10	1/1
Basitrichs (d)	19.8–29.3 (31.1) x (3.2) 3.8–4.9	52	4/4	Basitrichs	21.2–29.8 x 3.4–4.1	11	1/1
Holotrichs (e)	28.8–46.3 x 4.2–6.2	36	4/4	—	—	—	—
Actinopharynx				**Actinopharynx**			
Basitrichs (f)	23.9–33.6 (35.2) x 3.4–5.0 (5.4)	71	4/4	Basitrichs	26.4–32.2 x 3.0–3.9	10	1/1
Microbasic *p*-mastigophores* (g)	(19.9) 21.9–30.0 x 3.7–5.2 (5.5)	37	3/4	—	—	—	—
Mesenterial Filaments				**Mesenterial Filaments**			
Basitrichs (h)	14.3–17.9 x 2.3–3.2	24	3/4	Basitrichs	11.4–15.3 x 2.1–2.8	10	1/1
Basitrichs (i)	21.1–28.9 x 3.1–5.0	55	4/4	Basitrichs	25.4–30.4 x 3.0–3.4 (3.9)	10	1/1
Microbasic *p*-mastigophores (j)	(18.2) 20.6–30.9 x 3.2–4.9 (5.3)	46	4/4	—	—	—	—

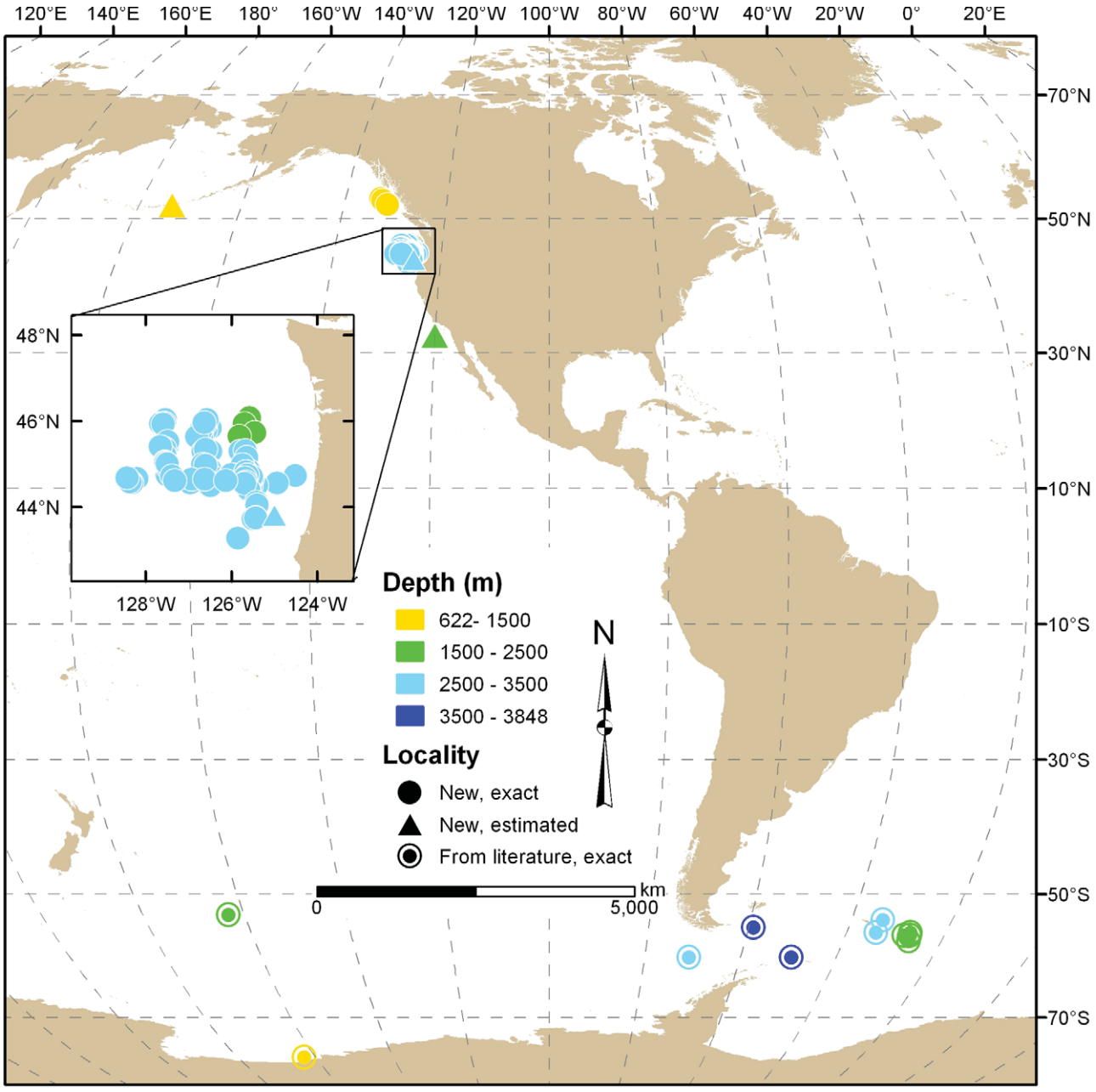

FIGURE 12. Distribution of *Actinoscyphia groendyki* n. sp. from the Southern and northeastern Pacific Ocean.

Dichotomous key of *Actinoscyphia.*

1 Six pairs of complete mesenteries 2

- More than six pairs of mesenteries complete, more than 50 pairs of mesenteries total. Edges of oral disc undulate or folded on itself, pedal disc much smaller than oral disc; attached to dead branches of *Lophelia* Milne-Edwards & Haime, 1849. North Atlantic Ocean. . . . . *A. verrilli* (Gravier, 1918)

2 Alveoli of marginal sphincter muscle pigmented 3

- Alveoli of marginal sphincter muscle lack pigmentation; oral disc slightly oval. Tentacles very long and thin (to about 50 mm long), thickened aborally at base. To five cycles of mesenteries. North Atlantic Ocean . . . . . *A. saginata* (Verrill, 1882)

3 Tentacles thickened aborally at base 4

- Tentacles lacking aboral thickenings, short and slender, to 275 total; tentacles, oral disc, actinopharynx, and all endoderm except that of filaments dark red/purple. To seven cycles of mesenteries, oral stomata present. Pedal disc small and concave, holds sediment and mucus. North Atlantic Ocean . . . . . *A. aurelia* (Stephenson, 1918)

4 Mesoglea thickest proximally (about 7 mm) and thinnest mid-column (about 1 mm). Mesogleal marginal sphincter muscle very short (less than 1/10 column length) and distinctly transversely striated throughout; under low magnification muscles look

like a single column of horizontally-oriented ovals stacked on top of each other. Oral disc flat and circular, may fold on itself; to about 250 tentacles. To six cycles of mesenteries; those of first and second cycles sterile. Oral stomata present. Holotrichs of tentacles absent (Table 2). Southeastern Pacific Ocean . . . . . *A. plebeia* (McMurrich, 1893)

- Mesoglea thick throughout column, to about 8 mm. Mesogleal marginal sphincter muscle about 1/3 column length; muscle with small alveoli, may be transversely striated near the proximal end. Oral disc oval, typically folded in half; to about 150 tentacles. To five cycles of mesenteries; those of first cycle and often second cycle sterile. Lack stomata. Holotrichs in tentacles (Table 2). Southern Ocean and northeastern Pacific Ocean . . . . . *A. groendyki* n. sp.

Family Actinostolidae Carlgren, 1932

Genus *Anthosactis* Danielssen, 1890

Anthosactis nomados White, Wakefield Pagels, and Fautin, 1999

(Figures 13–14, Appendix 6)

No synonyms

Diagnosis. Column light tan to white, very flat; to 65 mm diameter. Individuals typically attached to shells of scaphopod *Fissidentalium actiniophorum* Shimek, 1997 (Figure 13). Animals not attached to shells show evidence of once having been. Margin contracted so oral disc not visible. To 48 tentacles that taper to approximately 5 mm. Three cycles of mesenteries, first two complete; lack acontia. For a detailed description of *A. nomados,* see White *et al.* (1999).

Cnidae. Spirocysts, basitrichs, microbasic *p*-mastigophores, microbasic *b*-mastigophores.

Distribution. *Anthosactis nomados* was originally described from the northeastern Pacific off California and Oregon at 3,700–4,100 m (White *et al.* 1999). We examined additional specimens collected off California and Oregon from 530 to 4,325 m (Figure 14).

Material examined. See Appendix 6.

FIGURE 13. Specimen of *Anthosactis nomados* attached to shell of *Fissidentalium actiniophorum* (KUIZ 001559).

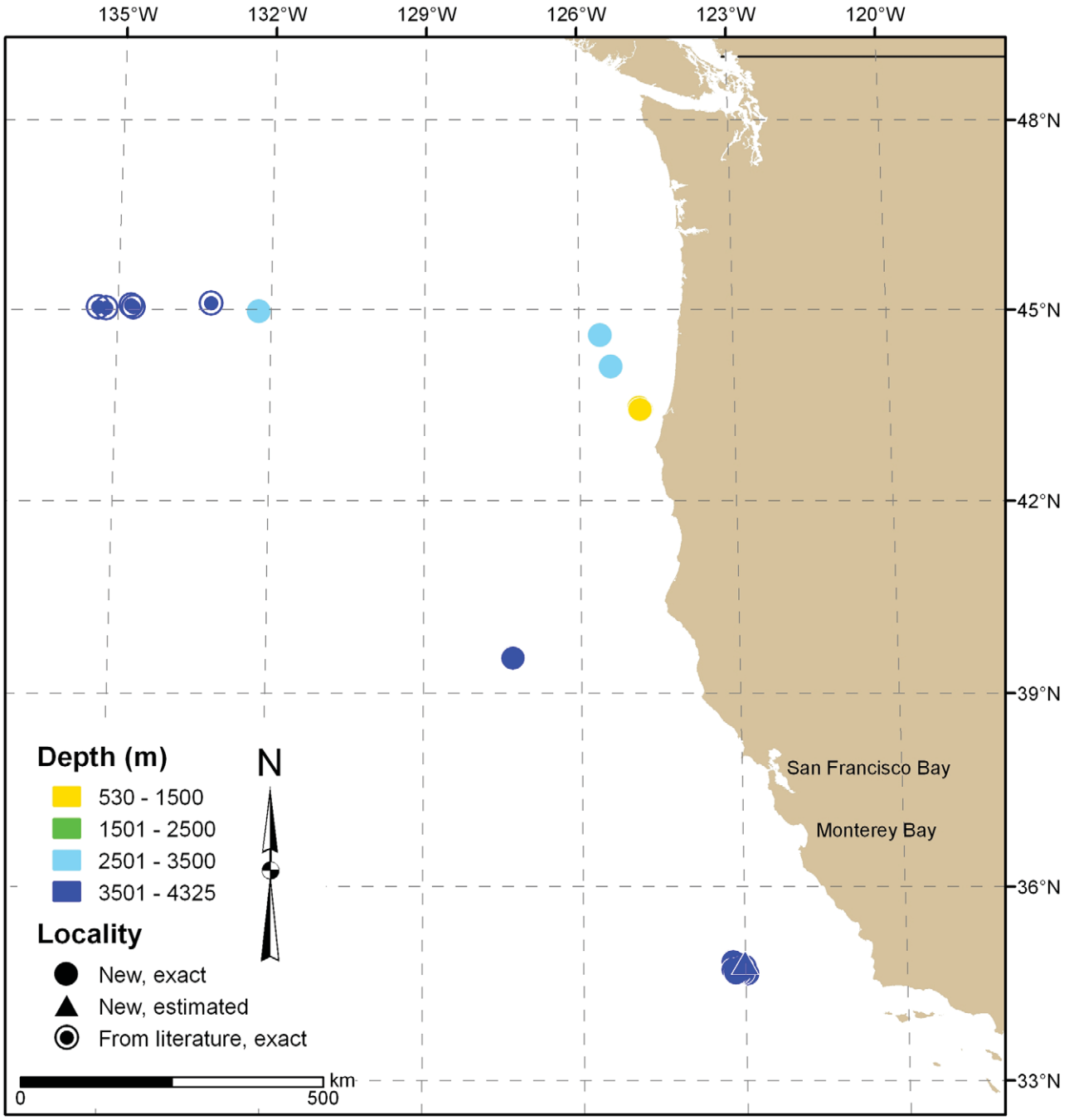

FIGURE 14. Distribution of *Anthosactis nomados* from California to Oregon.

Genus *Actinostola* Verrill, 1883

Actinostola faeculenta (McMurrich, 1893)

(Figures 15–17, Table 3, Appendix 7)

Synonyms

Cymbactis faeculenta: McMurrich (1893)
Paractinostola faeculenta: Carlgren (1949)

Diagnosis. Specimens typically lack ectoderm, exposing purple to white mesoglea (Figure 15). Column vasiform, with scattered, lumpy thickenings entire length; small specimens slightly translucent; brownish ectoderm may

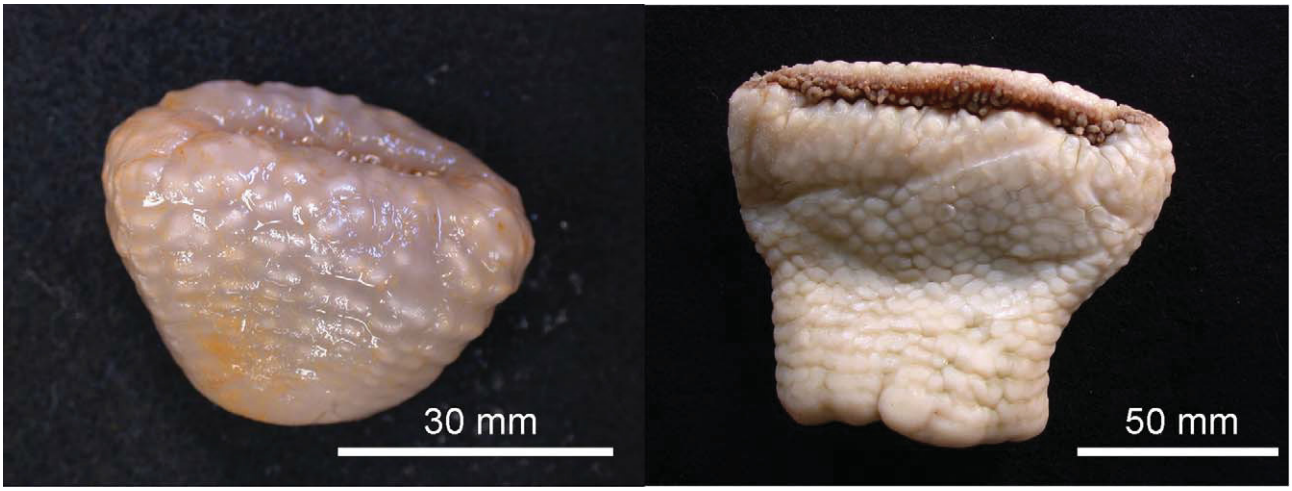

FIGURE 15. Specimens of *Actinostola faeculenta.* Small specimen on left (KUIZ 003301); large specimen on right (KUIZ 001459).

persist in crevices between thickenings. In smaller specimens thickenings more or less circular, in larger ones thickenings toward distal end elongated and tapered, resembling drips of viscous fluid; those near margin of contracted individual may be digitiform. Oral and pedal discs concave; pedal disc may be leathery. Column varies from about 15 mm wide and long to more than 200 mm wide and 150 mm long. Three to five cycles of mesenteries at mid-column; to three cycles of mesenteries complete (third cycle complete only distally). Mesenteries of first two cycles sterile, those of third to fifth cycle may be fertile. Additional small, thin mesenteries at only extreme proximal end, so numerous could not be counted. Number of mesenteries inferred to be equal to number of tentacles, which may exceed 200. Oral disc and tentacles typically solid tan (color of ectoderm remaining in crevices of column). Marginal tentacles very short, tightly packed; discal tentacles longer, pointed, may have shallow longitudinal furrows, and dispersed over marginal half of oral disc. For detailed information on *A. faeculenta,* see McMurrich (1893) and Carlgren (1934b).

Cnidae. Gracile and robust spirocysts, basitrichs, microbasic *p*-mastigophores, and microbasic *b*-mastigophores. Sizes and distribution of cnidae given in Table 3; cnidae illustrated in Figure 16.

Distribution. *Actinostola faeculenta* was described from six specimens collected north of the Channel Islands, California, USA at 757 m (McMurrich 1893). We examined additional specimens from southern California, north to British Columbia, and west to Japan from depths of 82 to 2,265 m (Figure 17).

Taxonomic remarks. This is among the largest and most massive, as well as one of the most distinctive, sea anemones in the deep northeastern Pacific.

Specimens of *A. faeculenta* we examined agreed with both McMurrich (1893) and Carlgren (1934b). The large specimens have more than 200 tentacles. The type specimens have about 150, which is similar to the number in smaller specimens we examined; therefore, it appears that number of tentacles (and, by inference, mesenteries) increases with size.

Despite how conspicuous the species is, cnidae size and distribution in specimens of *Actinostola faeculenta* had not previously been reported so we report them here (Table 3).

McMurrich (1893) could not find gametogenic tissue in the type specimens of *Cymbactis faeculenta*, so fertility pattern was not part of the generic definition. Although Carlgren (1934b) was also unable to detect gametogenic tissue in the type specimens, he moved the species from *Cymbactis* to *Paractinostola* (Carlgren, 1928a), a genus he had established (Carlgren 1928a) for *P. bulbosa* (Carlgren, 1928a) and *P. capensis* (Carlgren, 1928a), based on a more or less strongly lobed oral disc and fewer mesenteries at the base than tentacles. In his catalog to sea anemones of the world, Carlgren (1949) questionably also placed *Cymbactis faeculenta* in *Paractinostola*. Should the three species belong in a single genus, it would be termed *Cymbactis*, the older name [no other species have been attributed to *Paractinostola*; the combination *Paractinostola ingolfi*, found in Fautin and Barber (1999), is a *lapsus* for *Parasicyonis ingolfi* Carlgren, 1942: Fautin 2011].

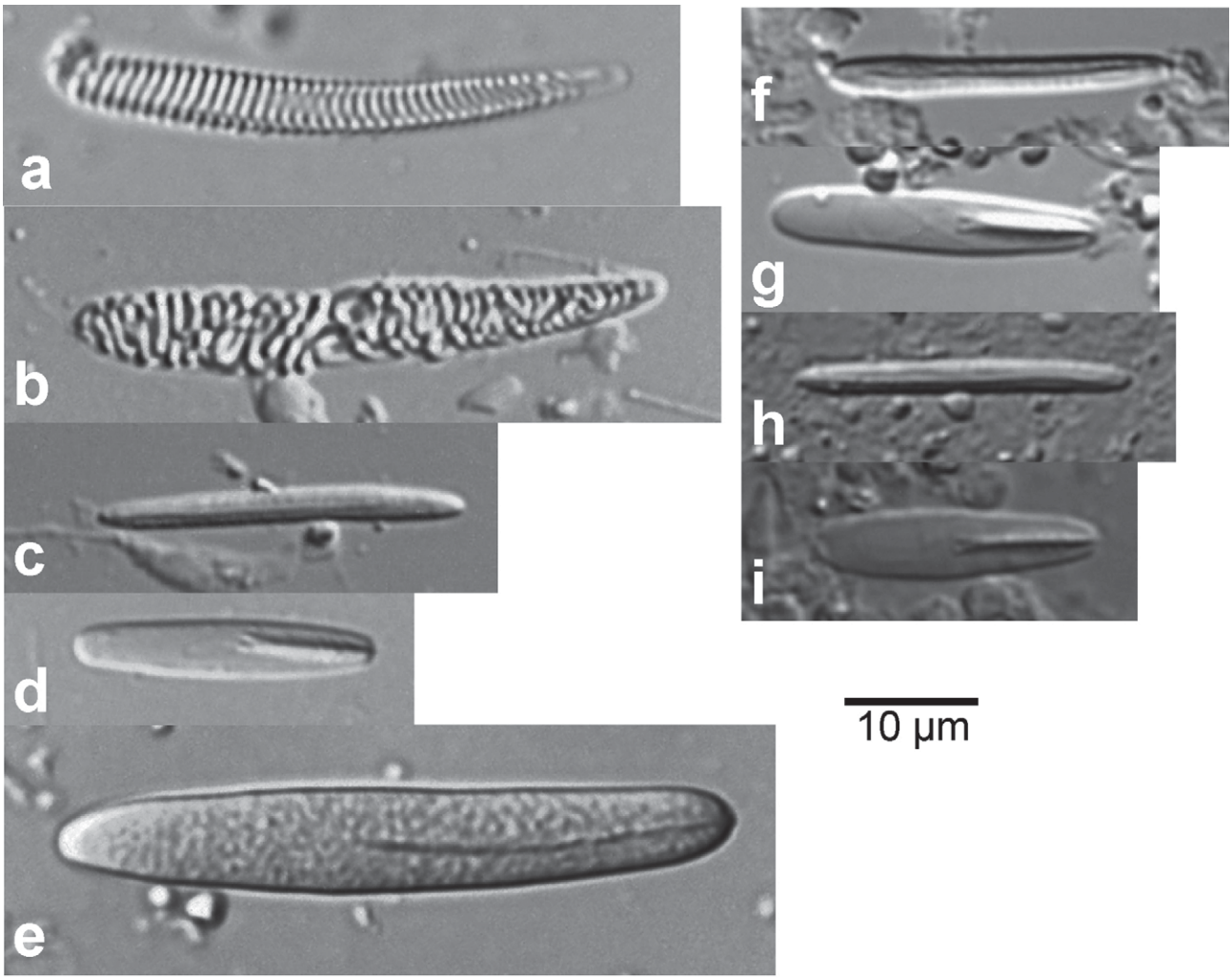

FIGURE 16. Cnidae of *Actinostola faeculenta*; distribution and dimensions in Table 3. a. Gracile spirocyst; b. robust spirocyst; c. basitrich; d. microbasic *p*-mastigophore; e. microbasic *b*-mastigophore; f. basitrich; g. microbasic *p*-mastigophore; h. basitrich; i. microbasic *p*-mastigophore.

Riemann-Zürneck (1971) questioned the basis of differentiating *Actinostola* from *Paractinostola*. She subsequently (Riemann-Zürneck 1978) placed *P. bulbosa* and *P. capensis* in *Actinostola*, finding the features Carlgren (1928a) used to define *Paractinostola* insufficient to distinguish it from *Actinostola*; however, she did not mention *P. faeculenta*.

The key distinction between *Cymbactis*, as described by McMurrich (1893), and *Actinostola*, as described by Carlgren (1949), is the lobed margin of members of *Cymbactis*. Riemann-Zürneck (1978) noted that the margin of some specimens belonging to species of *Actinostola* can be lobed. Additionally, *C. faeculenta*, the type species of *Cymbactis*, has more tentacles than mesenteries at the base, a character not true for *Actinostola* according to Carlgren (1949). Häussermann (2005 [correction to Häussermann 2004]), who analyzed the variability of characters in *Actinostola chilensis* McMurrich, 1904, found that some individuals of the species had more tentacles than mesenteries at the base and some had fewer. Thus these features do not distinguish *Cymbactis* from *Actinostola*. In examining fertile specimens of *C. faeculenta*, we found the first two cycles of mesenteries to be sterile; this state characterizes *Actinostola*. Therefore, *Cymbactis* conforms to the genus description of *Actinostola*, so *Cymbactis* is a junior synonym of *Actinostola*.

Material examined. See Appendix 7.

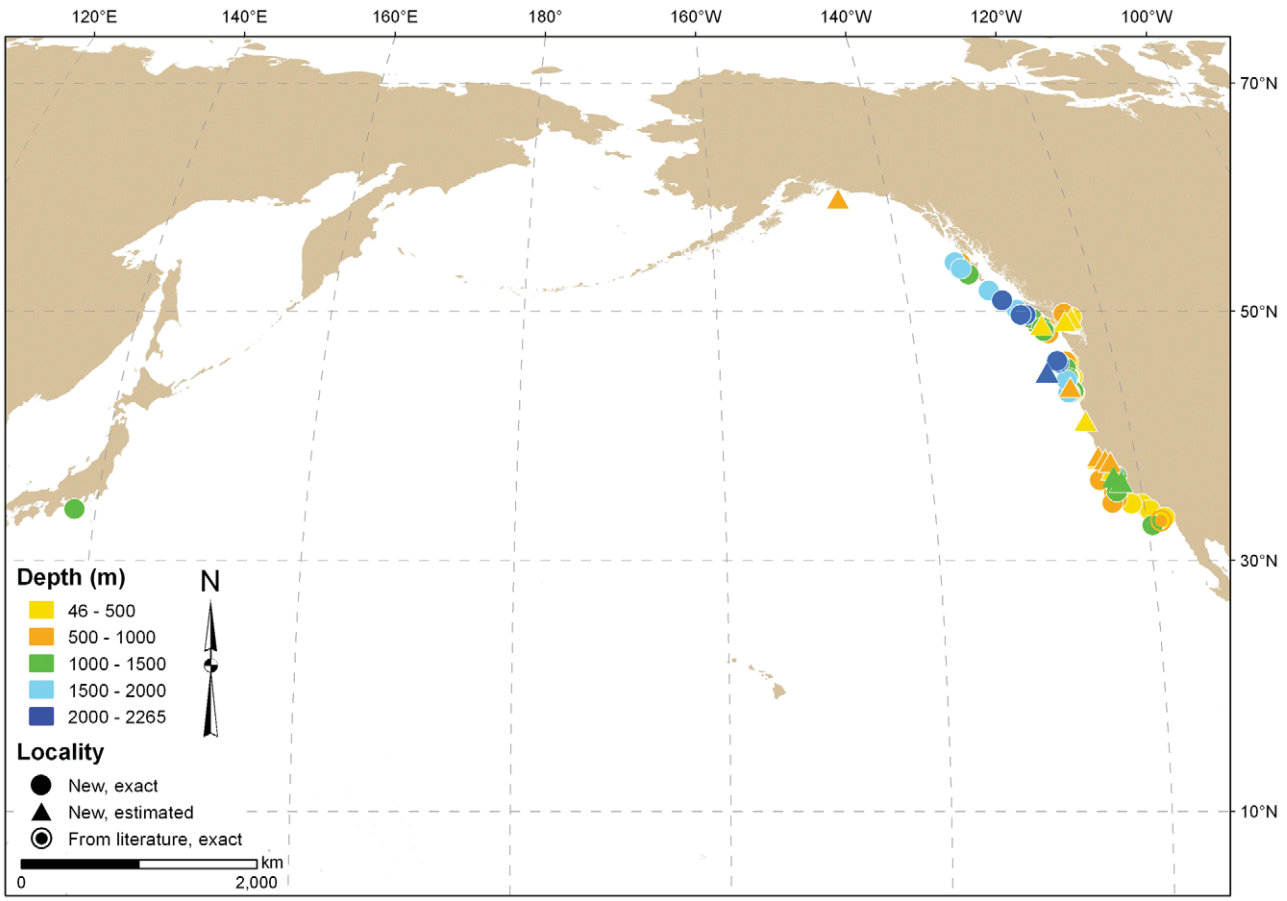

FIGURE 17. Distribution of *Actinostola faeculenta* in North Pacific Ocean.

TABLE 3. Cnidae size and distribution of *Actinostola faeculenta*.

Tissue and Cnida Type	Length x Width (µm)	n	N
Tentacles			
Gracile Spirocysts (a)	20.2–50.4 x 2.6–5.3	105	4/4
Robust Spirocysts (b)	(24.9) 27.2–58.5 (62.2) x 3.2–7.5 (7.9)	103	4/4
Basitrichs (c)	19.9–33.5 (37.2) x 1.9–3.1	138	4/4
Microbasic *p*-mastigophores (d)	17.3–26.0 (27.4) x 3.1–5.4	91	4/4
Microbasic *b*-mastigophores (e)	38.5–56.9 x 6.5–10.8	70	3/4
Actinopharynx			
Basitrichs (f)	22.4–31.2 x 2.3–3.1	31	3/3
Microbasic *p*-mastigophores (g)	19.9–26.9 (30.9) x 3.4–5.4	27	3/3
Mesenterial Filaments			
Basitrichs (h)	(23.0) 24.4–33.9 x 2.3–3.4 (3.6)	31	3/3
Microbasic *p*-mastigophores (i)	18.4–28.3 x 4.1–6.1 (6.9)	30	3/3

Genus *Sicyonis* Hertwig, 1882

Sicyonis careyi n. sp.

(Figures 18–21, Table 4, Appendix 8)

Body form and size. Column of specimens white to light grey (color of exposed mesoglea). Stiff due to thick mesoglea (to 6 mm mid-column in specimen 39 mm long); smooth except for few shallow irregular furrows; mesenterial insertions rarely visible. Cylindrical column of preserved specimens may be slightly compressed laterally (likely due to compression in collecting net), tentacles partially hidden in all specimens examined. Oral and pedal disc approximately same diameter, or column may taper slightly from oral to pedal disc (Figure 18). Column of most specimens examined 33–56 mm long, shortest 10 mm long.

Pedal disc. Pinkish brown; smooth but rare furrows may mark insertions of mesenteries toward periphery. Typically 24–42 mm diameter (7 mm diameter in smallest specimen); concave, concavity reaching 16 mm long; typically grasping bolus of mud.

Oral disc and tentacles. Tan or brown, radially furrowed where mesenteries insert; hidden by tentacles and contracted column in all specimens examined. Diameter 34–48 mm (13 mm in smallest), roughly same diameter as column length. Mouth about 1/3 diameter of oral disc, same color as oral disc; two large white siphonoglyphs apparent.

Tentacles tan, circumferentially furrowed, slightly thickened aborally at base (Figure 19a); arrayed in 3 cycles, about 80 in number (58 in smallest specimen). Inner tentacles endocoelic and larger than outer (exocoelic); short, pointed, 2–8 mm long, taper from 2–4 mm at base to 0.5–1 mm at tip. Small pore at tip (Figure 19b) more apparent in endocoelic than exocoelic tentacles.

Internal anatomy. Actinopharynx tan, brown, or grey, long, longitudinally sulcate. Each of two deep, white siphonoglyphs attached to pair of directive mesenteries.

Mesenteries thin and numerous (about 80 pairs), irregularly arrayed; incomplete ones loosely follow *Actinostola* rule. Mesenteries of youngest cycle very thin and weak, exist only at extreme proximal end; lack filaments and musculature, possess gametogenic tissue (Figure 19c). All other mesenteries muscular with filaments and large mesogleal thickenings distally (Figure 19d). Mesenteries of second youngest cycle (typically 20 pairs) extend from pedal to oral disc but very small compared to those of older cycles; rarely possess gametogenic tissue. Oldest mesenteries (typically 20 pairs) sterile and long; most complete, although only one member or rarely both members of pair incomplete; contain oral but no marginal stomata.

Muscular mesenteries possess long, diffuse retractor muscles. Parietobasilar muscles weak, pennons lacking. Mesogleal marginal sphincter muscle weak and moderately long; lies against endoderm (Figure 19e), may be longitudinally striated distally. Occupies less than half column width distally, where alveoli large and loosely arrayed; tapers proximally, where more reticular toward endoderm, alveolar toward ectoderm.

Longitudinal musculature of tentacles mesogleal and well developed (Figure 19a).

Cnidae. Spirocysts, basitrichs, holotrichs, microbasic *p*-mastigophores. Sizes and distribution of cnidae given in Table 4; cnidae illustrated in Figure 20.

Type specimens. Holotype: SBMNH 422541, collected 18-Feb-1971 from 45.31° N 126.53° W, 2,750 m. Column length 39 mm, diameter of contracted distal end 46 mm, diameter of contracted proximal end 33 mm. 72 mesenteries span entire length of column and equal number gametogenic mesenteries exist only at proximal end; 72 tentacles.

Paratypes: KUIZ 003349, 3 specimens, collected 18-Feb-1971 from 45.31° N 126.53° W, 2,750 m; CAS 184530, 1 specimen, collected 16-Mar-1970 from 44.63° N 125.67° W, 2,816 m; RBCM 010-00572-001, 1 specimen, collected 16-Mar-1970 from 44.63° N 125.67° W, 2,816 m; USNM 1149363, 1 specimen, collected 16-Mar-1970 from 44.63° N 125.67° W, 2,816 m; SBMNH 149660, 2 specimens, collected 16-Mar-1970 from 44.63° N 125.67° W, 2,816 m.

Etymology. Named in honor of Andrew G. Carey, Jr. who collected specimens of this species, as well as many other deep-sea anemones, off the coast of Oregon.

Distribution. *Sicyonis careyi* n. sp. appears endemic to the northeastern Pacific, where it occurs from 550 to 3,700 m (Figure 21). No other member of the genus is known from the northeastern Pacific.

Taxonomic remarks. The genera *Parasicyonis* Carlgren, 1921, and *Synsicyonis* Carlgren, 1921, are so similar to *Sicyonis* that species in them merit comparison with *Sicyonis careyi* n. sp.

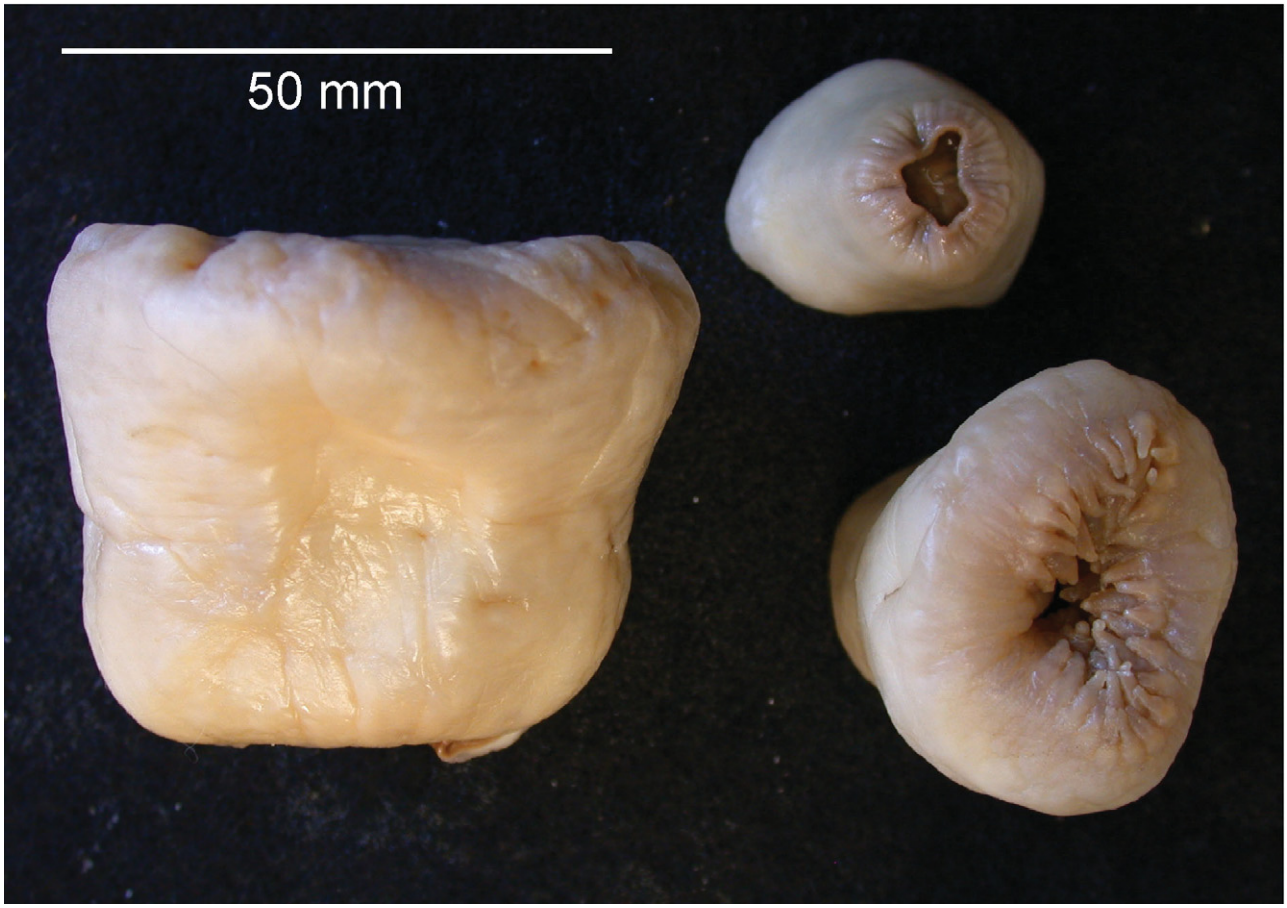

FIGURE 18. Specimens of *Sicyonis careyi* n. sp. Large holotype specimen on left (SBMNH 422541); two small paratypes specimens on right (KUIZ 003349).

TABLE 4. Cnida size and distribution of *Sicyonis careyi* n. sp. Shorter specimens have smaller cnidae. * Sparse.

Tissue and Cnida Type	Length x Width (µm)	n	N
Tentacles			
Gracile spirocysts (a)	25.3–49.9 (54.3) x 2.9–4.8 (5.2)	33	3/3
Robust spirocysts* (b)	(33.0) 35.4–50.9 (55.9) x (4.4) 4.8–6.0	17	3/3
Basitrichs (c)	27.6–45.5 x 3.3–4.2	37	3/3
Holotrichs (d)	25.9–47.0 x (3.2) 3.4–4.3 (4.6)	42	3/3
Actinopharynx			
Basitrichs (e)	32.3–43.3 (46.2) x 3.2–4.5 (4.8)	34	3/3
Microbasic *p*-mastigophores (f)	22.9–29.9 x 4.9–6.0	30	3/3
Mesenterial Filaments			
Basitrichs (g)	26.2–35.9 x 5.0–6.8	31	3/3
Microbasic *p*-mastigophores (h)	(15.2) 18.5–32.1 x 4.1–6.3 (6.8)	31	3/3

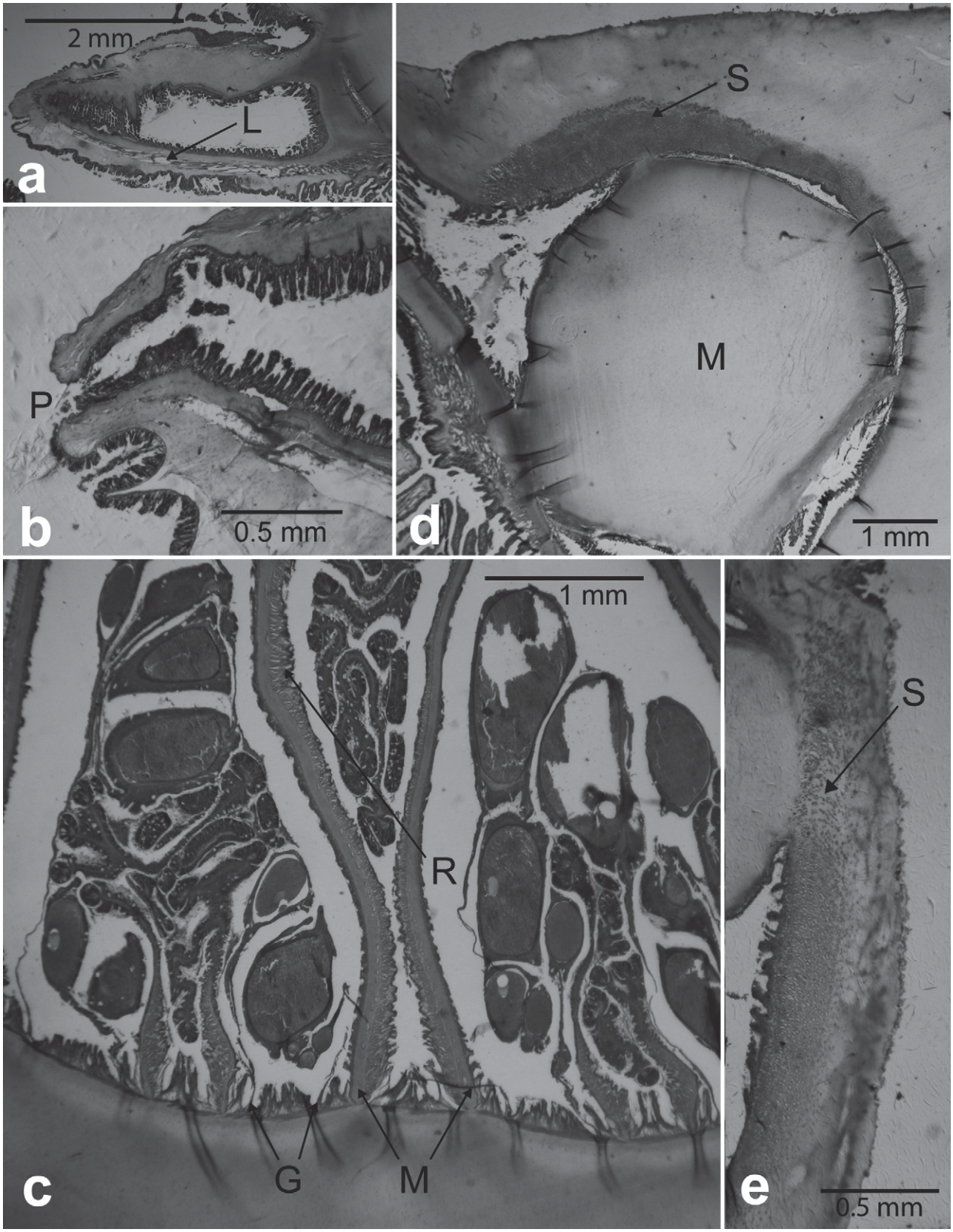

FIGURE 19. *Sicyonis careyi* n. sp. a. Tentacle with mesogleal longitudinal musculature (L); b. tentacle pore (P); c. muscular mesenteries (M) with diffuse retractor muscles (R) and non-muscular fertile mesenteries (G); d. mesogleal sphincter muscle (S) and thickened mesoglea at distal end of mesenteries (M); e. mesogleal sphincter muscle (S).

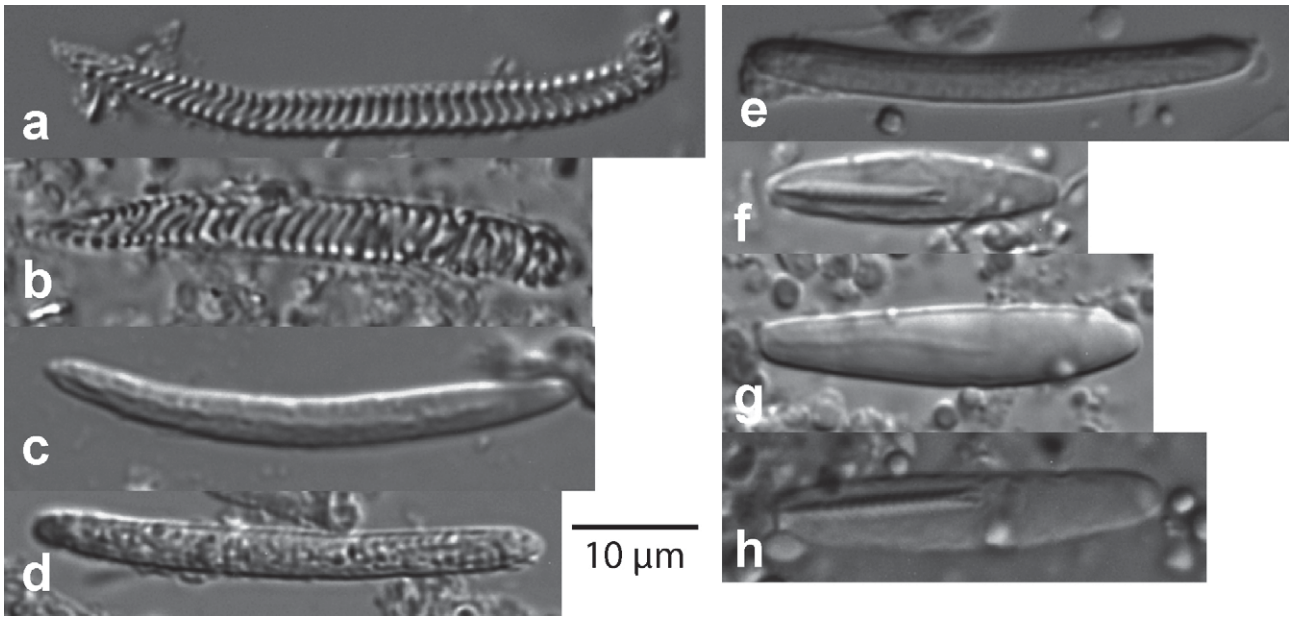

FIGURE 20. Cnidae of *Sicyonis careyi* n. sp.; distribution and dimensions in Table 4. a. Gracile spirocyst; b. robust spirocyst; c. basitrich; d. holotrich; e. basitrich; f. microbasic *p*-mastigophore; g. basitrich; h. microbasic *p*-mastigophore.

In both *Synsicyonis* and *Sicyonis*, mesenteries of the last cycle are fertile and lack filaments; the last cycle occurs only at the extreme distal end of the column in members of *Synsicyonis* and at the extreme proximal end of the column in members of *Sicyonis*. The only species of *Synsicyonis*, *S. elongata* (Hertwig, 1888), is known from the middle of the North Pacific at 5,304 m; mesenteries of its youngest cycle are muscular.

Mesenteries of the youngest cycle are fertile in members of *Parasicyonis* and *Sicyonis*; however, those of *Parasicyonis* possess mesenterial filaments, and those of *Sicyonis* lack mesenterial filaments. No species of *Parasicyonis* have been recorded from the Pacific Ocean.

In describing the North Atlantic *Sicyonis biotrans* Riemann-Zürneck, 1991, which possesses small filaments on mesenteries of the youngest cycle, Riemann-Zürneck (1991) argued that this character is not stable in *Sicyonis*. However, she did not provide evidence for that assertion, and the character appears consistent, to judge by specimens of *Sicyonis* we examined and descriptions of other species in the genus we read. Because the presence or absence of filaments on mesenteries of the youngest cycle is the only feature distinguishing the genera, and we are aware of no evidence that this character is unstable, the species is properly *Parasicyonis biotrans* (Riemann-Zürneck, 1991).

Material examined. See Appendix 8.

Differential diagnosis. *Sicyonis careyi* n. sp. can be distinguished from its congeners by its combination of: smooth mesoglea; smooth and thin pedal disc; weak alveolar marginal sphincter muscle; oral stomata; about 80 aborally thickened tentacles; about 80 pairs of mesenteries, of which those of the youngest and rarely the penultimate cycle are fertile.

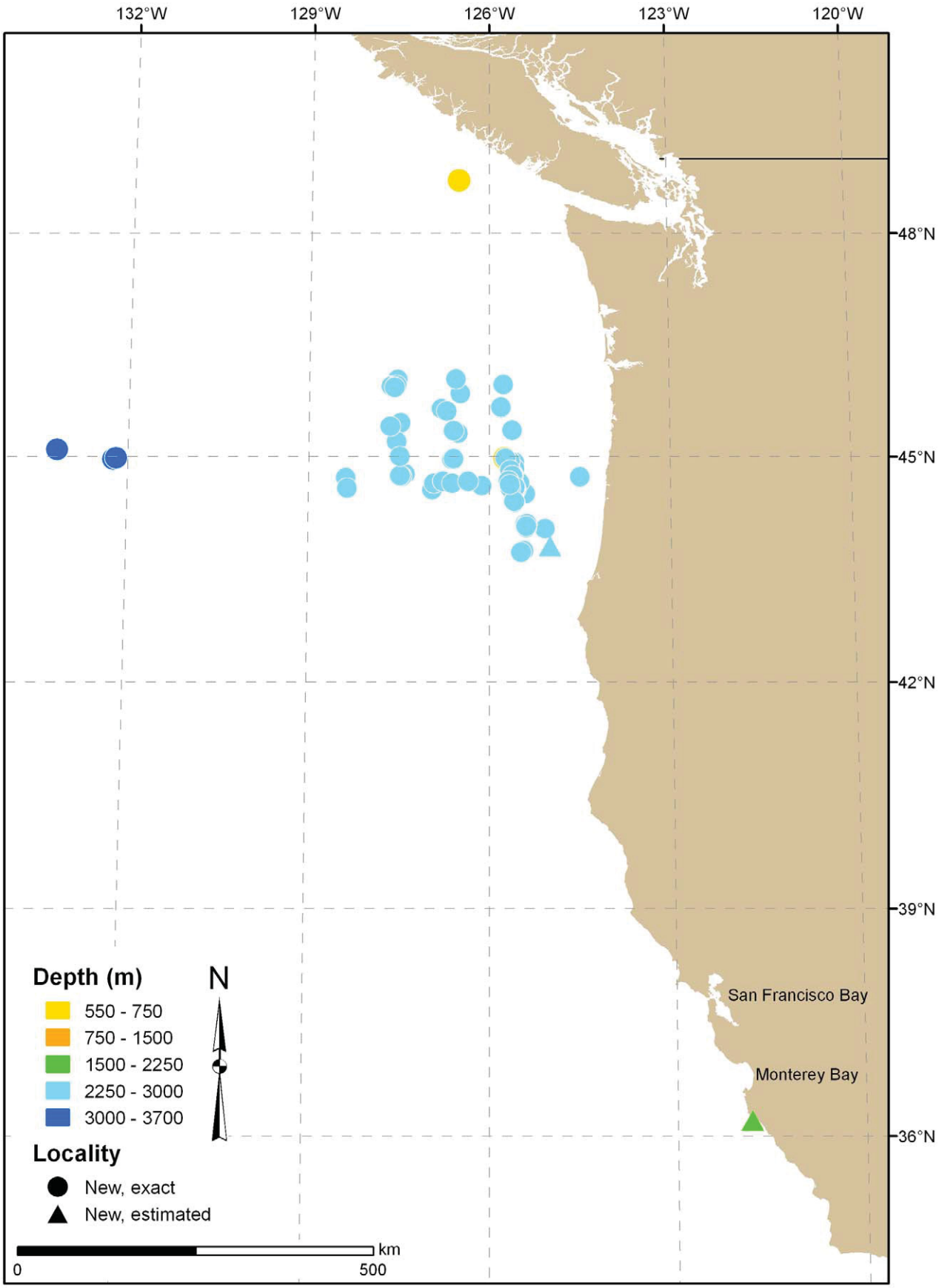

FIGURE 21. Distribution of *Sicyonis careyi* n. sp. from California to British Columbia.

Dichotomous key to species of *Sicyonis.*

1 Tentacles thickened aborally 2
- About 70 tentacles; not thickened aborally. About 100 pairs of mesenteries, to 21 pairs complete, some additional pairs with only one member complete; oral and marginal stomata present. North Atlantic Ocean . . . . . *S. variabilis* Carlgren, 1921
2 Basal aboral thickening of each tentacle does not project as large swollen bulb 3
- Basal aboral thickening of each tentacle projects as large swollen bulb. Marginal sphincter muscle mesh-like, interrupted by strips of mesoglea. Oral stomata on all mesenteries; marginal stomata only on stronger mesenteries. Some rare mesenteries of penultimate cycle fertile. North Atlantic Ocean . . . . . *S. tuberculata* Carlgren, 1921
3 More than 100 tentacles 4
- Fewer than 100 tentacles 5
4 About 144 tapered tentacles, of differing lengths. 144 pairs of mesenteries. North Atlantic Ocean . . . . . *S. gossei* (Stephenson, 1918)
- About 200 large tentacles, all same length. To five cycles of mesenteries. Off Japan . . . . . *S. tubulifera* (Hertwig, 1882)
5 Marginal sphincter muscle well developed, half or more of width of mesoglea 6
- Marginal sphincter muscle poorly developed, less than half width of mesoglea 7
6 Youngest mesenteries fertile, exist only near base. Column smooth, with shallow furrows distally; marginal sphincter muscle long, reticular near endoderm, alveolar near ectoderm. North Atlantic Ocean. . . . . *S. hemisphaerica* Carlgren, 1934a
- Youngest mesenteries fertile, extend far distally. Column smooth; marginal sphincter muscle long, striated and reticular. Off Indonesia . . . . . *S. sumatriensis* Carlgren, 1928a
7 Tentacles conical 8
- Tentacles wart-like. Column short with deep constriction in center. No microbasic *p*-mastigophores in actinopharynx. Southern Indian Ocean . . . . . *S. crassa* Hertwig, 1882
8 Only mesenteries of youngest cycle fertile; column longitudinally furrowed distally 9
- Mesenteries of youngest cycle and other young ones fertile; column not longitudinally furrowed distally. One size class of basitrichs in mesenterial filaments 10
9 Marginal sphincter muscle more alveolar than reticular, not stratified. Column approximately twice as wide as long. Fifteen pairs of mesenteries plus one additional member of a single pair complete. North Atlantic Ocean . . . . . *S. obesa* (Carlgren, 1934b)
- Marginal sphincter muscle alveolar and stratified. Column only slightly wider than long. At least 16 pairs of mesenteries complete; single members of additional mesentery pairs may be complete. Oral and marginal stomata present; marginal stomata typically on only stronger mesenteries. North Atlantic Ocean . . . . . *S. ingolfi* Carlgren, 1921
10 Column smooth, typically circumferentially furrowed proximally, pink to red ectoderm typically in furrows; mesoglea fibrous distally. Oral stomata present. Pedal disc brown, thick, furrowed. Marginal sphincter muscle reticular. Microbasic *p*-mastigophores in actinopharynx; basitrichs of mesenterial filaments 13–20 µm long. Southern Ocean . . . . . *S. erythrocephala* (Pax, 1922)
- Column white, smooth, with very shallow irregular furrows (likely artifact of collection), devoid of ectoderm; mesoglea smooth, not fibrous. Oral stomata present. Pedal disc pinkish-brown, furrowed only near limbus, thin. Marginal sphincter muscle with large alveoli distally; proximally reticular toward endoderm, alveolar toward ectoderm. Microbasic *p*-mastigophores in actinopharynx; basitrichs of mesenterial filaments 26–36 µm long. Northeastern Pacific Ocean. . . . . *S. careyi* n. sp.

Family Bathyphelliidae Carlgren, 1932

Genus *Bathyphellia* Carlgren, 1932

Bathyphellia australis Dunn, 1982

(Figures 22–23, Appendix 9)

Synonym

Daontesia australis: Riemann-Zürneck (1994)

Diagnosis. Elongate column (to about 30 mm) tapered distally. Scapus rough, dark, covered in tenaculi holding multistratified cuticle and typically debris; where tenaculi sloughed, scapus tan, smooth. Scapus short, smooth, orangish. Margin of most specimens contracted, oral disc hidden. Pedal disc typically attached to manganese nodule (Figure 22). Mesenteries in three cycles, all with somewhat restricted diffuse retractor muscles; six pairs of macrocnemes. Acontia small, difficult to locate (as is common in members of family Bathyphelliidae [Carlgren 1956; Dunn 1983; Riemann-Zürneck 1997]). For a detailed description of *B. australis,* see Dunn (1983).

Cnidae. Spirocysts, basitrichs, microbasic *p*-mastigophores.

Distribution. *Bathyphellia australis* was described from five specimens collected in the South Pacific Ocean at 3,200–4,575 m (Dunn 1983). The hundreds of specimens we have examined from California to Oregon extend the species' range geographically and to as shallow as 2,709 m (Figure 23). We infer that members of *B. australis* occur all along the eastern rim of the Pacific Ocean at appropriate depths.

Taxonomic remarks. Being congeners, *Bathyphellia australis* and *B. margaritacea* (Danielssen, 1890) resemble one another in some respects. They differ in geographic distribution and microhabitat, the latter recorded only from the North Atlantic and Arctic Oceans (Danielssen 1890; Carlgren 1942; Doumenc 1975; Riemann-Zürneck 1997; Sanamyan *et al.* 2009), embedded in soft sediment. Although similar, their cnidae differ. The tall cylindrical form of *B. australis* is virtually invariant because its dense tenaculi prevent it from shortening, whereas that of *B. margaritacea* is "trumpet-shaped" and variable in length:width ratio (Sanamyan *et al.* 2009: 1246). We found small acontia in all specimens of *B. australis* but, according to Sanamyan *et al.* (2009) they may be absent in some specimens of *B. margaritacea.*

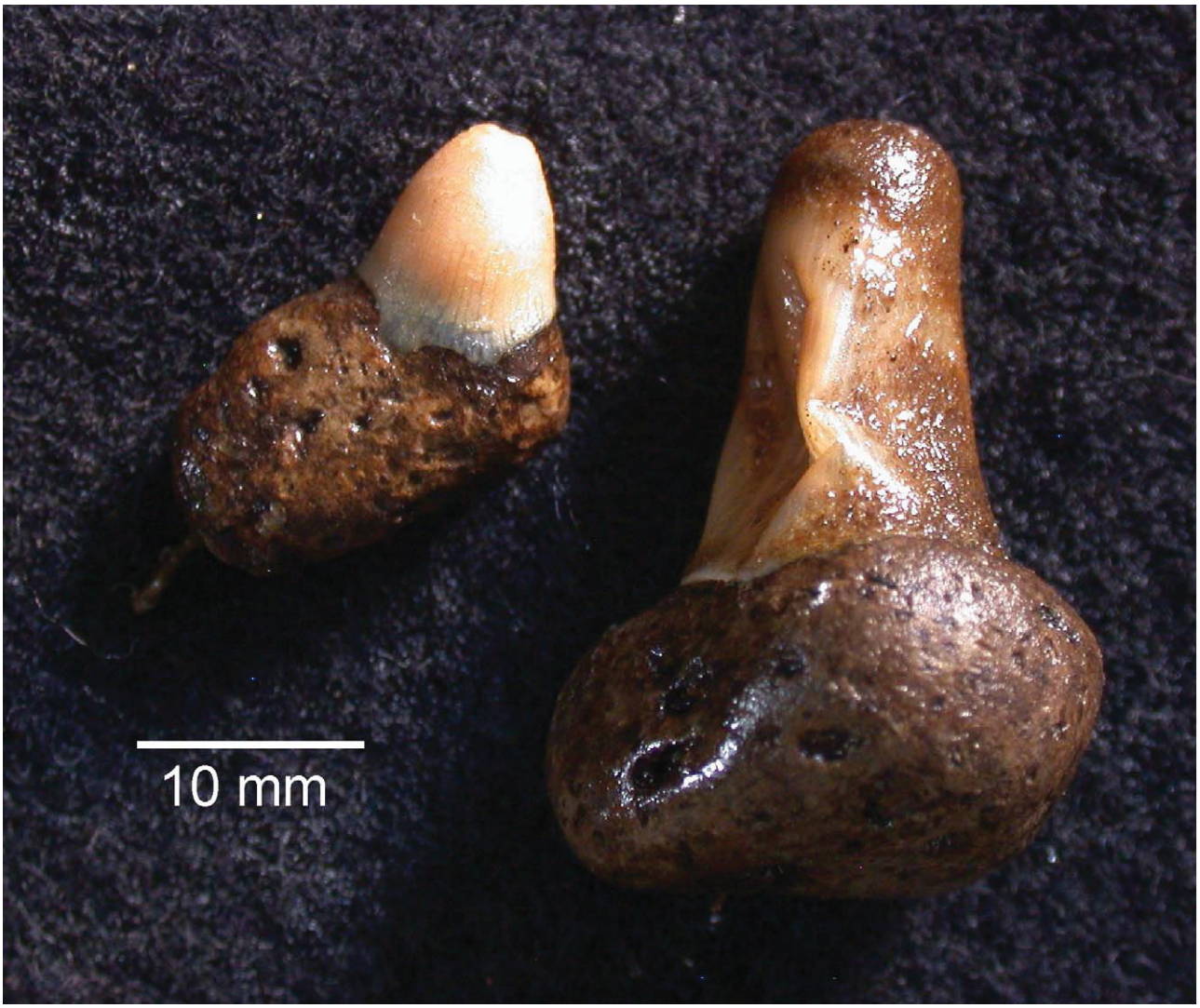

FIGURE 22. Specimens of *Bathyphellia australis,* each attached to a manganese nodule (KUIZ 002167).

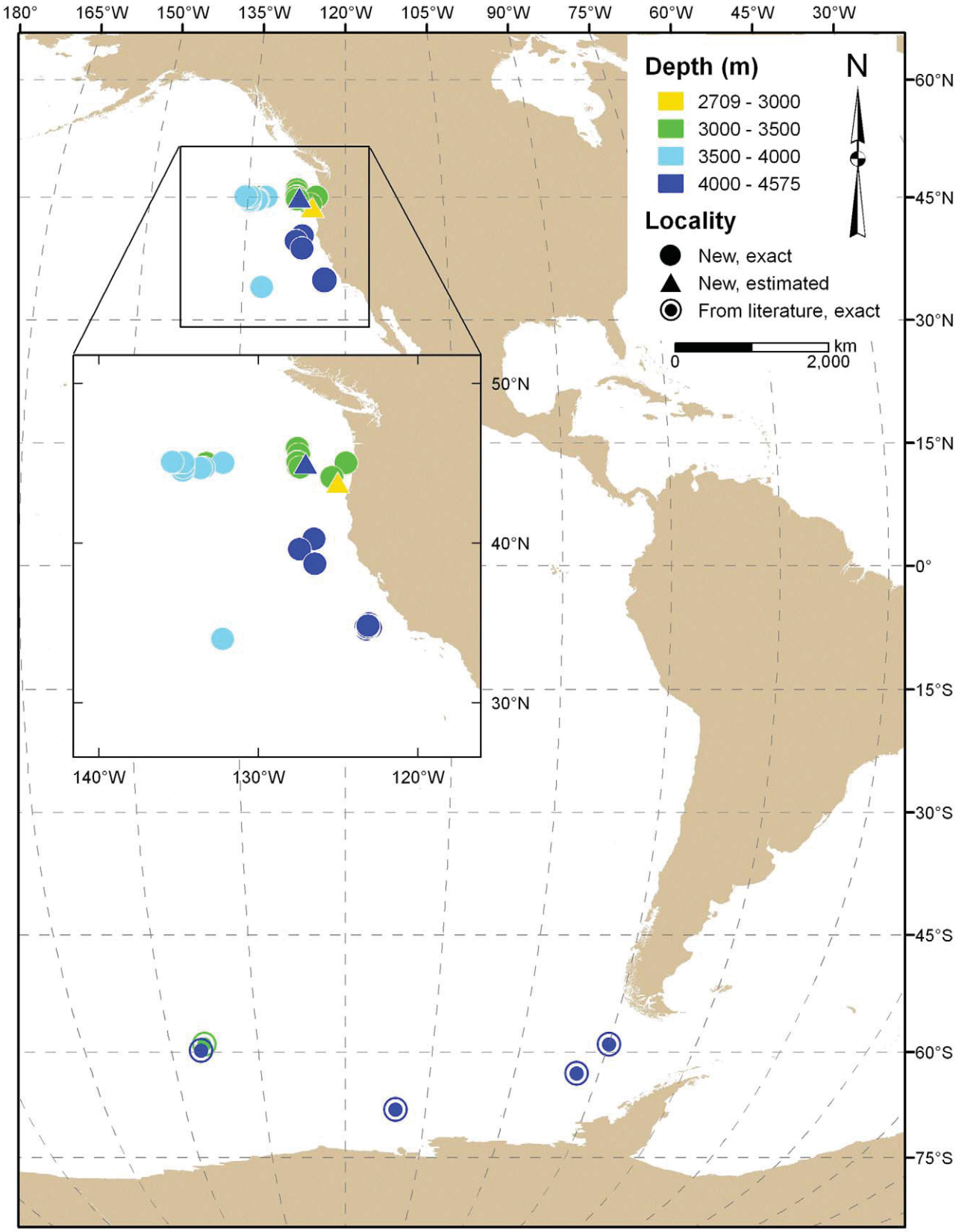

FIGURE 23. Distribution of *Bathyphellia australis* in Southern and northeastern Pacific Ocean.

Riemann-Zürneck (1997) moved *Bathyphellia australis* to *Daontesia* Carlgren, 1942 in light of her revised definition of the genus, giving primacy to the character of a multistratified cuticle, a feature shared with the type species of the genus, *Daontesia praelonga* (Carlgren, 1928b), as noted by Dunn (1982). Two characters separate

Daontesia and *Bathyphellia* in the key of Carlgren (1949), the number of macrocnemes (12 in the former, six in the latter) and the number of tentacles (same as the number of mesenteries in the former, fewer in the latter). Riemann-Zürneck (1997: 367) did not mention the number of tentacles in her revised definition of *Daontesia* but stated the number of macrocnemes as "six or 12 pairs," despite both *D. praelonga* and *D. porcupina* Riemann-Zürneck, 1997, having only six pairs, and added to the definition "Tentacle ectoderm with a peculiar *b*-mastigophore." Cinclides may occur in *Daontesia*. *Bathyphellia australis* has 12 macrocnemes and lacks cinclides; we have not found in the tentacles the distinctive type of nematocyst characterizing *Daontesia*. We therefore retain *B. australis* in the genus *Bathyphellia.*

Material examined. See Appendix 9.

Family Hormathiidae Carlgren, 1932

Genus *Actinauge* McMurrich, 1893

Actinauge verrillii McMurrich, 1893

(Figures 24–25, Appendix 10)
Synonyms: see below

Diagnosis. Shape depends on substratum: most specimens attached to gastropod shell, cylindrical object such as worm tube or sponge spicules, or bolus of mud. Column to 46 mm long. Scapus covered in tubercles; tubercles small toward base, more pronounced toward margin; brown cuticle typically remains only in furrows between tubercles (Figure 24). In specimens examined, column contracted, hiding oral disc; tentacles rarely visible. Same number of tentacles as mesenteries (about 96: four cycles); tentacles tapered, thickened aborally. For detailed information on *A. verrillii,* see McMurrich (1893) and Dunn (1983).

Cnidae. Spirocysts, basitrichs, microbasic *p*-mastigophores.

Distribution and taxonomic remarks. *Actinauge verrillii* was originally described from 15 specimens collected from off the Galapagos Islands, Chile, and the Channel Islands of California from 717, 1,238, and 757 m, respectively (McMurrich 1893). Specimens have also been trawled in the Southern Ocean (Dunn 1983).

Additionally, the species has been reported from the Atlantic Ocean in trawls as shallow as 0–450 m but those records are incorrect (see Carlgren 1949; Riemann-Zürneck 1986). Riemann-Zürneck (1986) described the species *Actinauge cristata* Riemann-Zürneck, 1986, from the northwestern Atlantic Ocean for specimens that had been identified as *A. verrillii*.

FIGURE 24. Specimens of *Actinauge verrillii.* Voucher specimen on left (SBMNH 422707) attached to worm tube; syntype specimen on right (USNM 17807).

Thus, *A. verrillii* appears to be restricted to the Southern and Pacific Oceans. Specimens we examined extended the species' previously known range to the Aleutian Islands and to depths of at least 119 m to 4,250 m (see Appendix 10) (Figure 25).

Material examined. See Appendix 10.

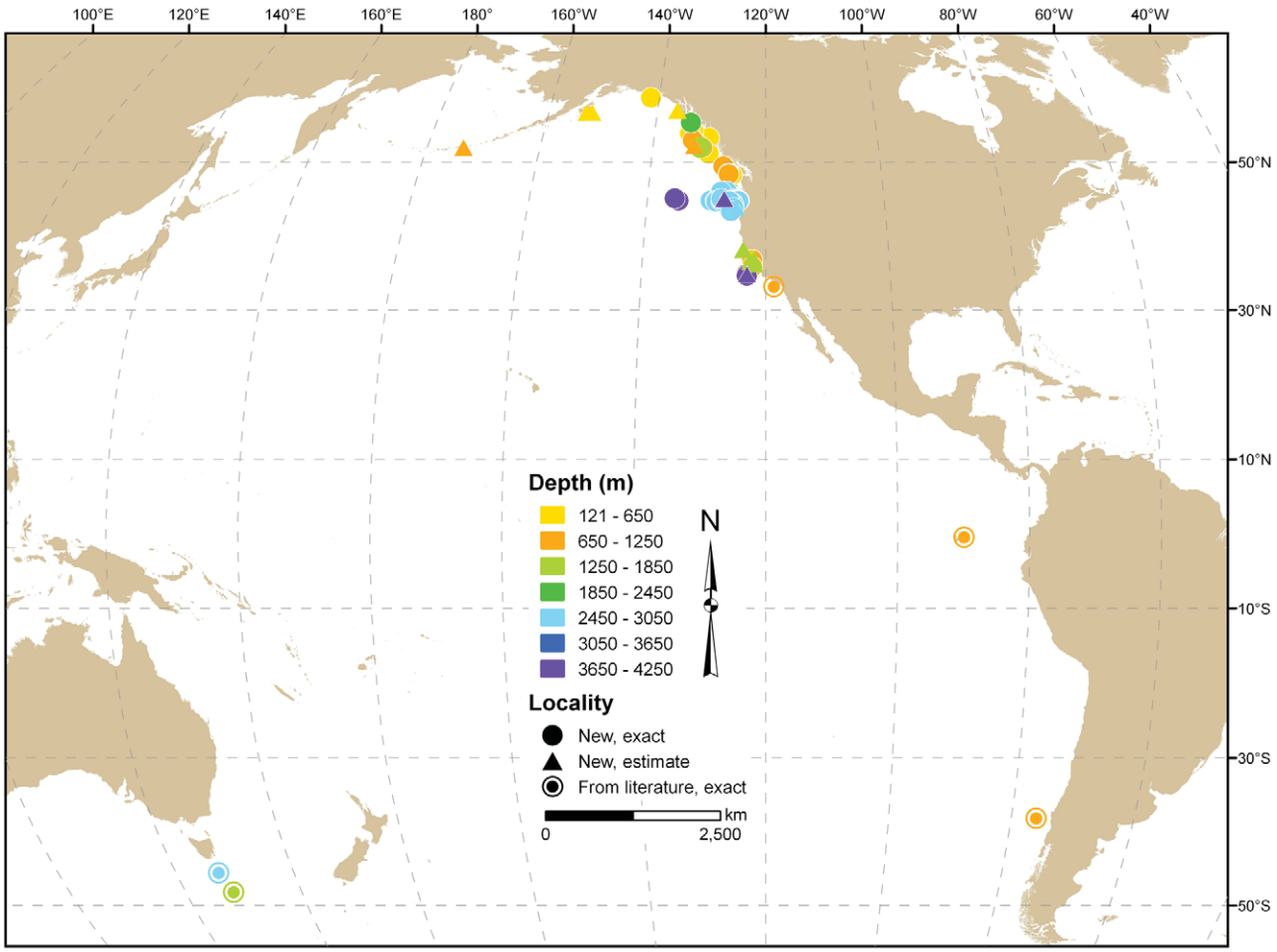

FIGURE 25. Distribution of *Actinauge verrillii* in Southern and Pacific Oceans.

Genus *Monactis* Riemann-Zürneck, 1986

Monactis vestita (Gravier, 1918)

(Figures 26–27, Appendix 11)

Synonym

Paractis vestita: Gravier, 1918

Diagnosis. Body form (Figure 26) presumably depends on object attached to (gastropod, rock, cylindrical object); body tall, flat, or elongate. Diameter of pedal disc to approximately 40 mm; length of column to 18 mm. Column tan, smooth; margin typically contracted so oral disc hidden. About 32 tentacles; may be hidden by contracted margin. Mesenteries arrayed in four cycles; those of only first cycle complete and with acontia. Acontia difficult to distinguish from filaments. For detailed information on *M. vestita,* see Gravier (1918), Riemann-Zürneck (1986), Zamponi and Acũna (1992), and White *et al.* (1999).

Cnidae. Spirocysts, basitrichs, microbasic *p*-mastigophores.

Distribution. *Monactis vestita*, the only species in its genus, was originally described from specimens collected from the northeastern Atlantic Ocean at 2,286 to 5,005 m (Gravier 1918). Animals of this species have been found off the coasts of Venezuela (Riemann-Zürneck 1986) and Oregon (White *et al.* 1999); we did not find additional specimens. The species is known in the Atlantic and Pacific Oceans from 59 to 5,320 m (Figure 27).

Material examined. See Appendix 11.

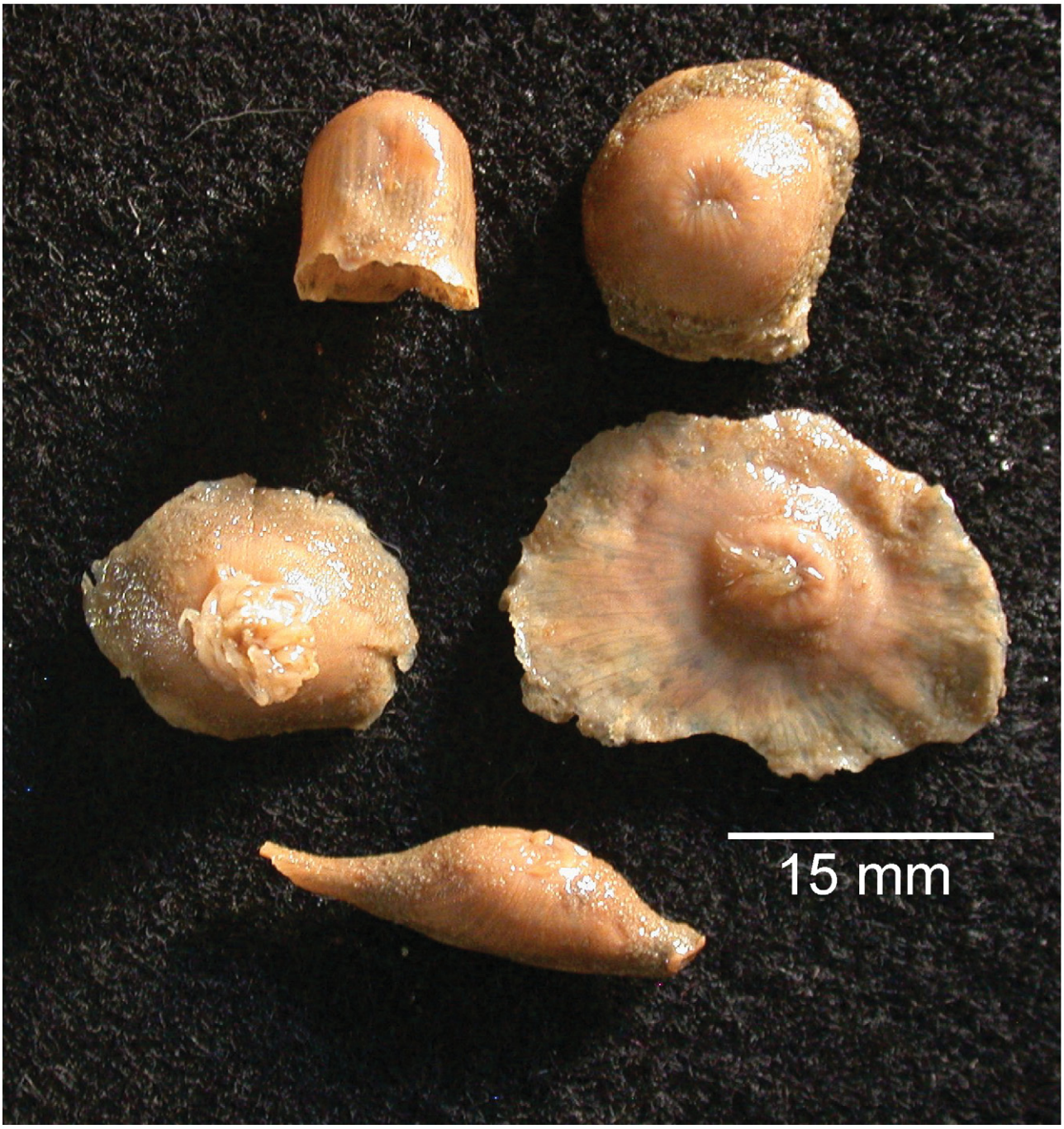

FIGURE 26. Specimens of *Monactis vestita* with a variety of body forms (KUIZ 001210).

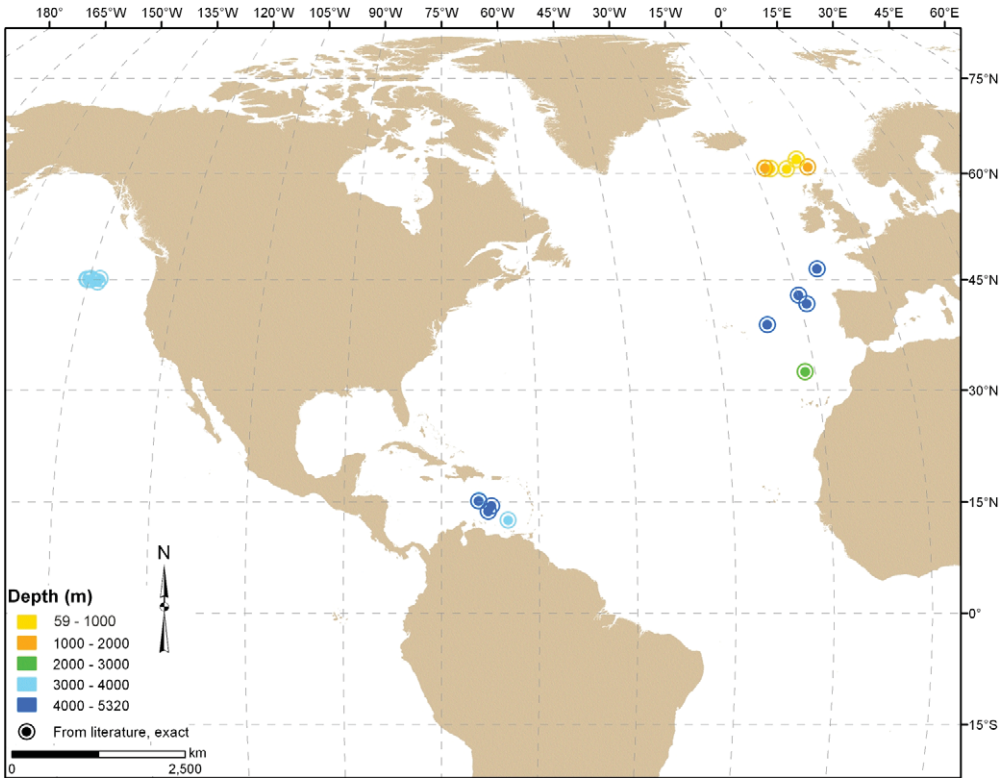

FIGURE 27. Distribution of *Monactis vestita* in North Atlantic and Pacific Oceans.

Genus *Paraphelliactis* Carlgren, 1928b

Paraphelliactis pabista Dunn, 1982

(Figures 28–29, Appendix 12)

No synonyms

Diagnosis. Column light tan to brown, 10 to 80 mm long; pointed tubercles arrayed in longitudinal rows along endocoels. Pedal disc often attached to cylindrical object such as worm tube (Figure 28) or holds small stone or bolus of mud. Aborally thickened tentacles more numerous than mesenteries at mid-column (to more than 150 tentacles vs. 96 mesenteries). For a detailed description of *P. pabista,* see Dunn (1982); Sanamyan and Sanamyan (2007) added information.

Cnidae. Spirocysts, basitrichs, microbasic *p*-mastigophores.

Distribution. *Paraphelliactis pabista* was described from off the coast of British Columbia (Dunn 1982). Sanamyan and Sanamyan (2007) reported the species in the Gulf of California, Mexico. We examined additional specimens from California to British Columbia and extend the depth range of the species to 1,426 to 4,100 m (Figure 29).

Taxonomic remarks. The other species of *Paraphelliactis*, *P. spinosa* Carlgren, 1928b (the type species) and *P. michaelsarsi* Carlgren, 1934a, were moved to *Phelliactis* Simon, 1892, by Riemann-Zürneck (1973). However, Riemann-Zürneck (1973) did not report the ratio of mesenteries to tentacles in specimens of the two species, key to distinguishing the genera. Thus, as Sanamyan and Sanamyan (2007) contended, the type species of *Paraphelliactis* (*P. spinosa*) should be regarded as valid and *Paraphelliactis pabista* should remain the valid name of the species we examined from the northeastern Pacific.

Material examined. See Appendix 12.

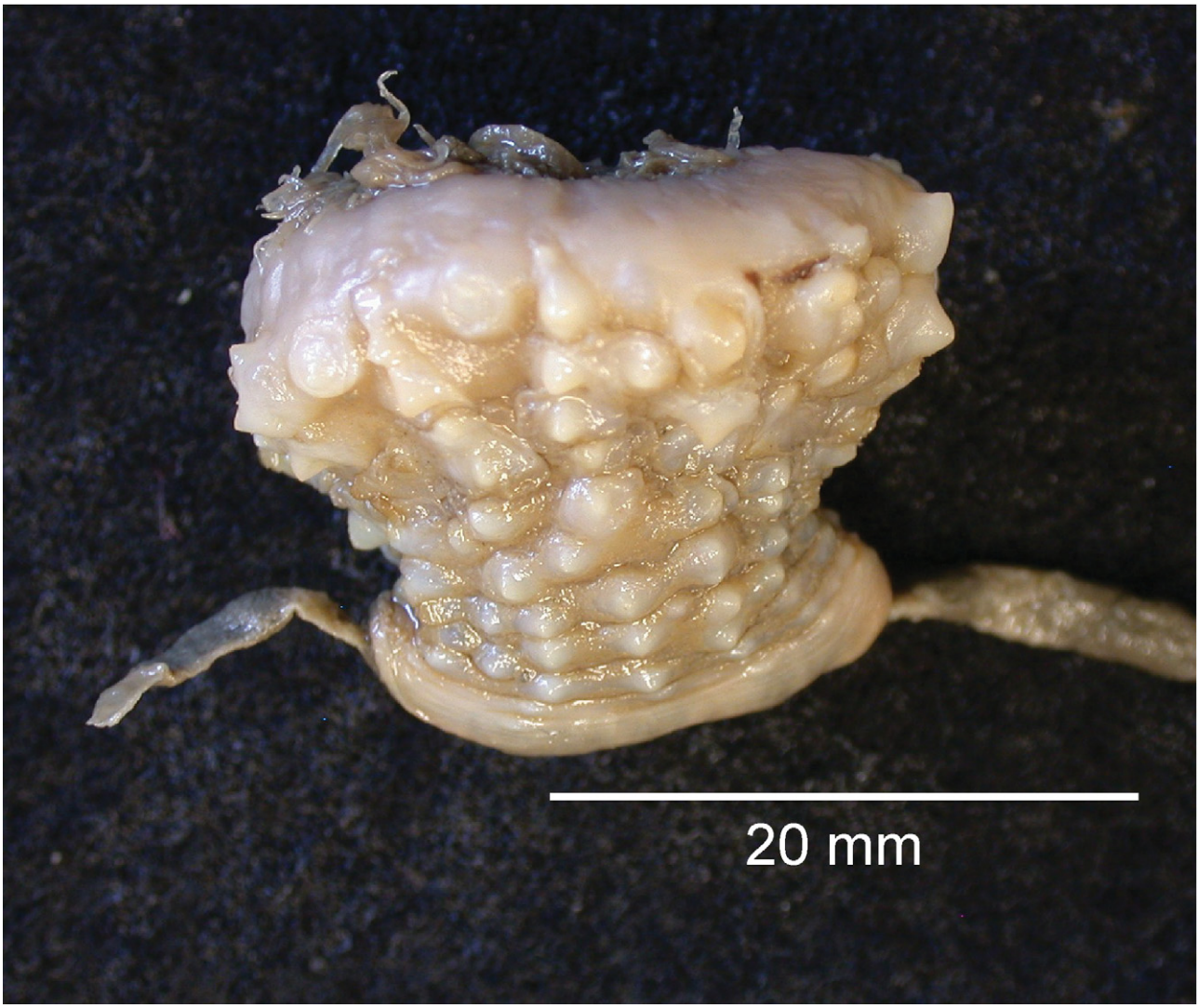

FIGURE 28. Specimen of *Paraphelliactis pabista* attached to worm tube (SBMNH 83609).

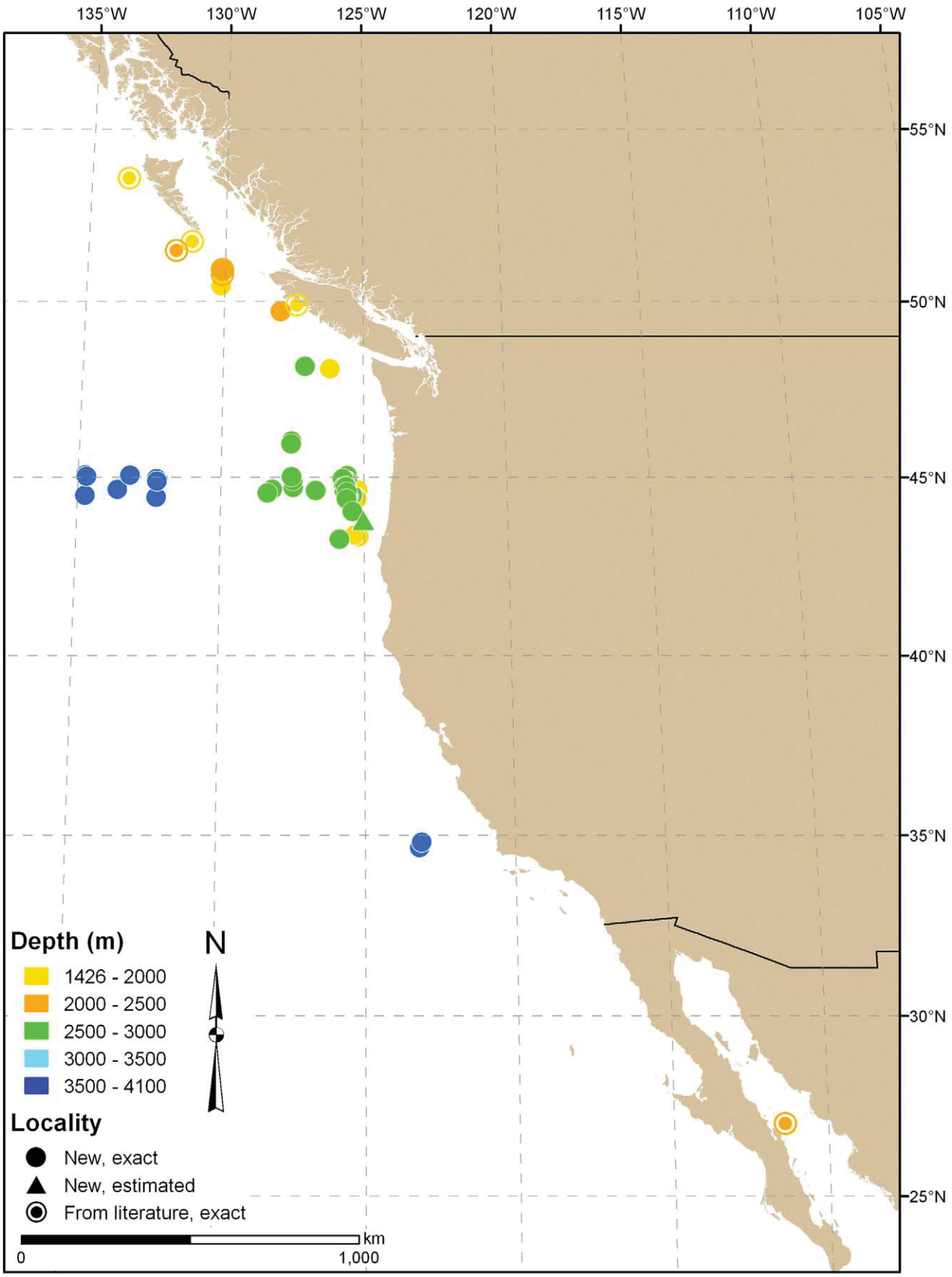

FIGURE 29. Distribution of *Paraphelliactis pabista* from Mexico to British Columbia.

Family Liponematidae Hertwig, 1882

Genus *Liponema* Hertwig, 1888

***Liponema brevicorne* (McMurrich, 1893)**
(Figures 30–31, Appendix 13)
Synonym

Bolocera brevicornis: McMurrich, 1893

Diagnosis. Oral disc of preserved specimens tan to pink; diameter to approximately 100 mm, expanded so completely hides short column; covered in short tentacles (Figure 30), one tentacle per endocoel, more than one per exocoel. Tentacles deciduous (as typical for members of *Liponema*); sphincter muscle at base of each. Bottoms of jars with preserved specimens often filled with detached tentacles. For a detailed description of *L. brevicorne,* see McMurrich (1893); Dunn and Bakus (1977) redescribed the species.

Cnidae. Spirocysts, basitrichs, microbasic *p*-mastigophores.

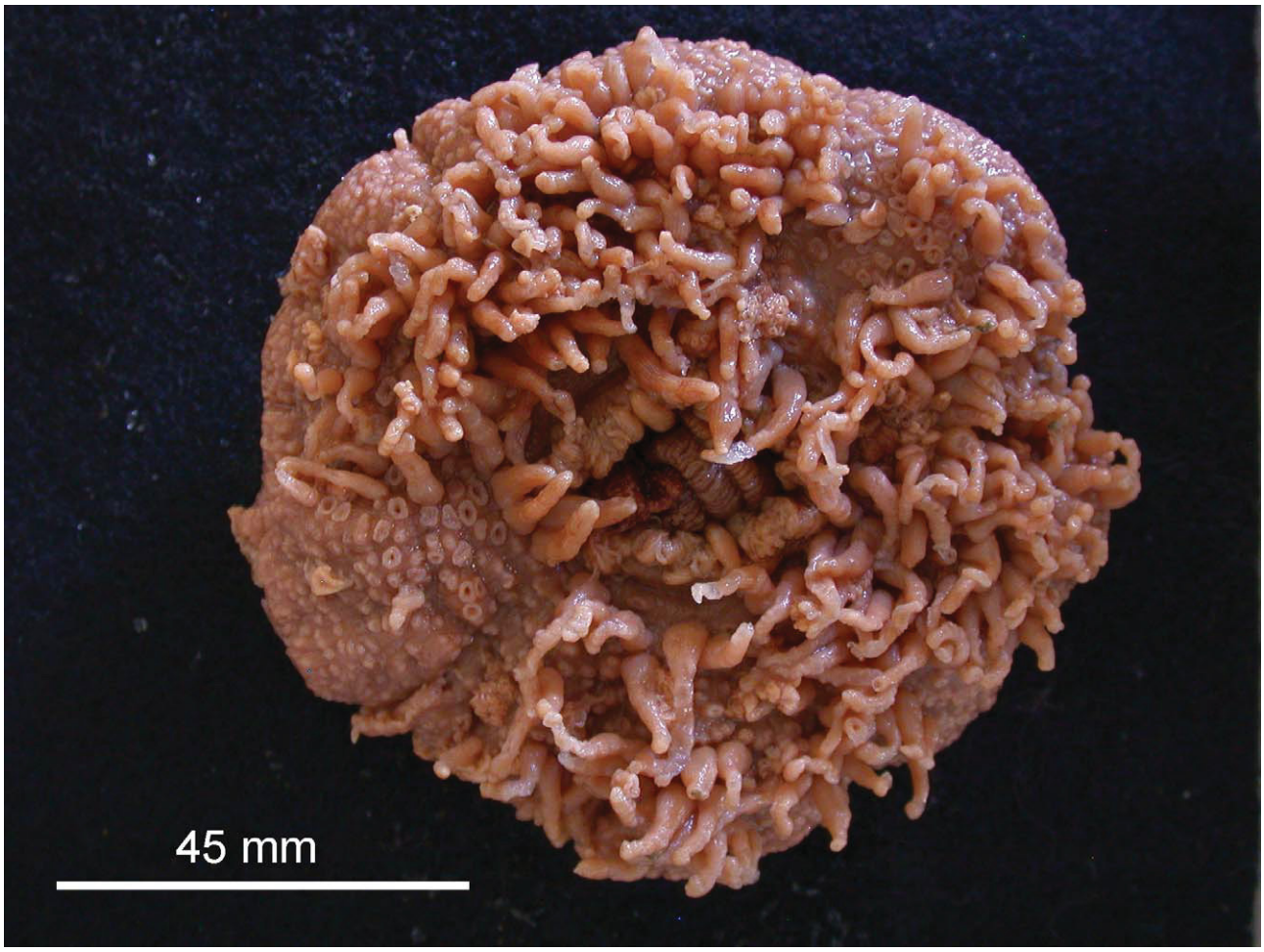

FIGURE 30. Oral disc of *Liponema brevicorne* missing about half its tentacles (KUIZ 003280).

Distribution. *Liponema brevicorne* was originally described from north of the Channel Islands, at 757 m (McMurrich 1893). Additional specimens, including some examined by us, have been collected throughout the North Pacific to the Aleutian Islands and Japan, extending the depth range of the species to 102 to 4,134 m (Figure 31).

In life, specimens are typically unattached on the sea floor (Dunn & Bakus 1977).

Taxonomic remarks. *Bolocera*, the genus in which this species was described, is feminine, so the species name was rendered *brevicornis*; the proper first Latin declension adjective form for the neuter genus, *Liponema*, is *brevicorne*.

Material examined. See Appendix 13.

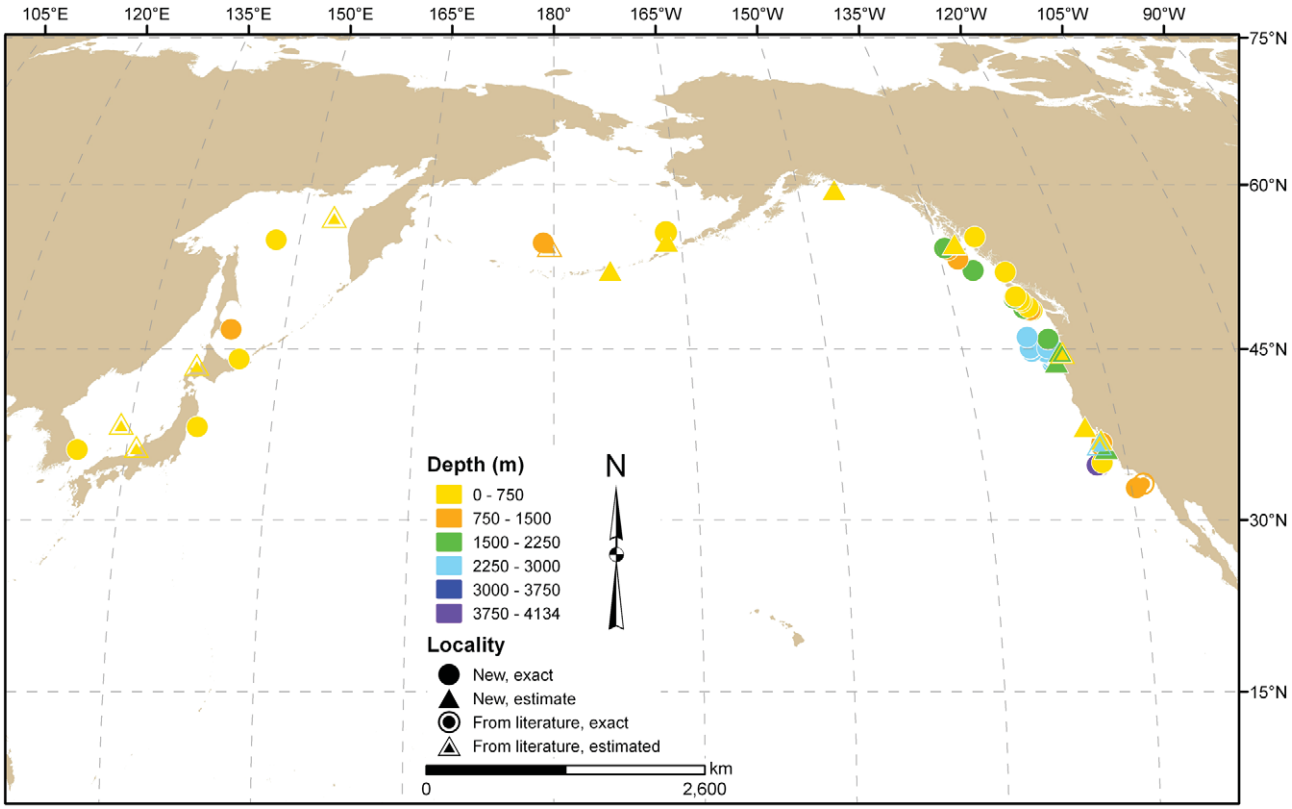

FIGURE 31. Distribution of *Liponema brevicorne* from southern California to Japan.

Family Metridiidae Carlgren, 1893

Genus *Metridium* de Blainville, 1824

Metridium farcimen (Brandt, 1835)

(Figures 32–33, Appendix 14)

Synonyms: see Fautin and Hand (2000)

Diagnosis. Specimens to 1 m long in life (Fautin *et al.* 1989); preserved specimens greatly contracted (100 mm or less in length). Column smooth, white to pale salmon or brown. Margin typically contracted, partially or completely hiding oral disc (Figure 32). Oral disc with lobes thickened with mesoglea. Oral disc covered in hundreds of tentacles; marginal tentacles shorter than discal tentacles. Pedal disc typically attached to rock or shell. For a detailed description of *M. farcimen,* see Fautin *et al.* (1989).

Cnidae. Spirocysts, basitrichs, microbasic *p*-mastigophores, microbasic amastigophores.

Distribution. *Metridium farcimen* was described by Brandt (1835) from Kamchatka, Russia. Specimens have since been collected throughout the North Pacific Ocean and we extend the range of the species from subtidal waters to 2,740 m, north to the Bering Sea and within the North Pacific from Mexico to Russia (Figure 33).

Taxonomic remarks. Fautin *et al.* (1989) described as a new species *Metridium giganteum* Fautin, Bucklin, and Hand, 1989, distinguishing it from the two other species found along the northeastern Pacific coast, *M. senile* (Linnaeus, 1761) and *M. exile* Hand, 1956. However, Fautin and Hand (2000) found several names that had previously been applied to this species: its valid name is *M. farcimen* (Brandt, 1835).

Its great size and lobed oral disc make large specimens of *Metridium farcimen* among the most distinctive species of sea anemone in the North Pacific. However, small specimens of *M. farcimen* have been confused with and misidentified as *M. senile* in publication, and because of their similarities, it is not possible to determine which were the subject of some publications (Fautin & Hand 2000). Specimens of *M. farcimen* can grow much larger than specimens of *M. senile,* which reach a maximum length of only 100 mm (Fautin *et al.* 1989). The oral disc of *M. farcimen* is divided into distinct stiffened lobes whereas the oral disc of *M. senile* is flaccid and the lobes are less distinct.

Material examined. See Appendix 14.

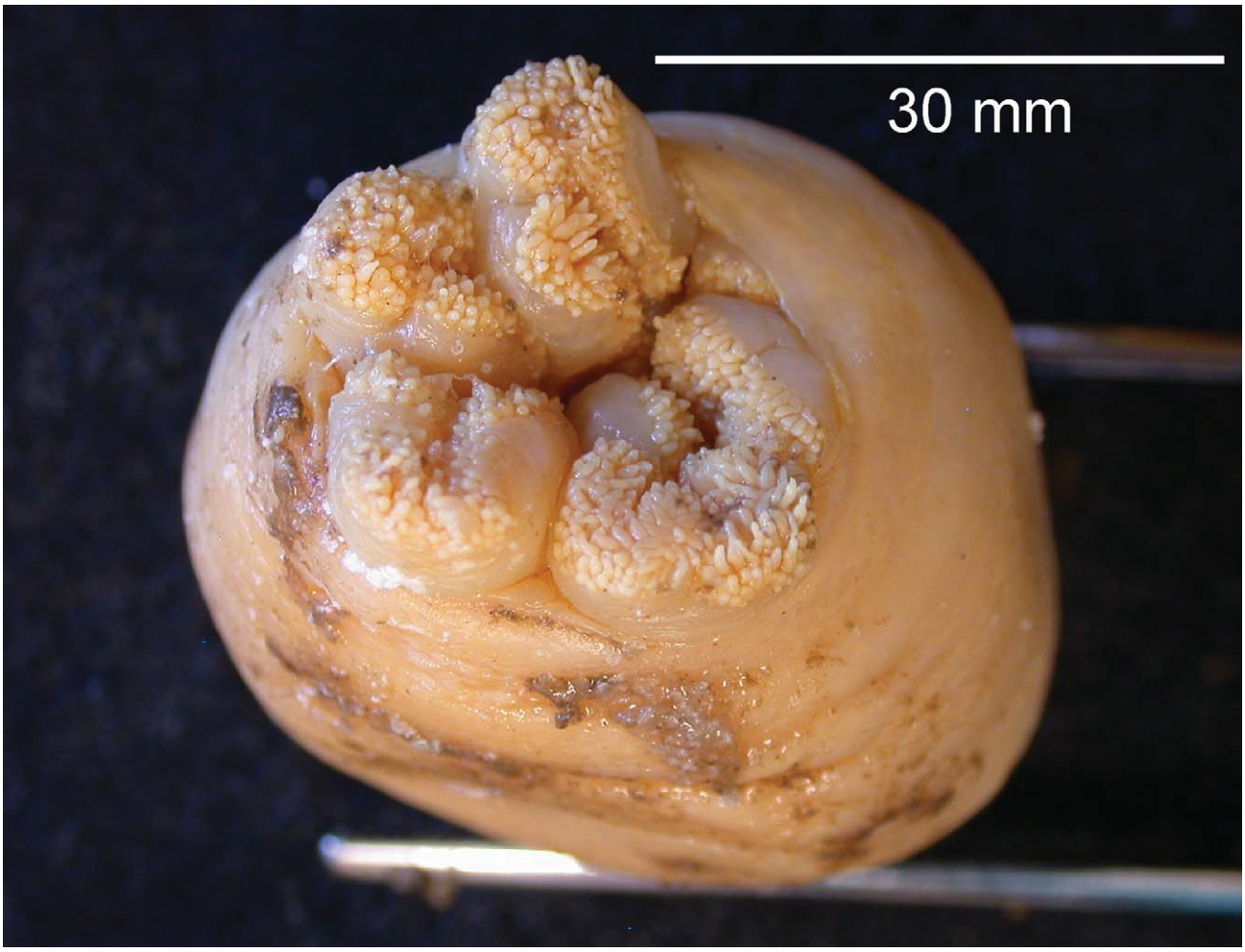

FIGURE 32. Oral view of *Metridium farcimen* showing stiffened lobes of oral disc (KUIZ 001436).

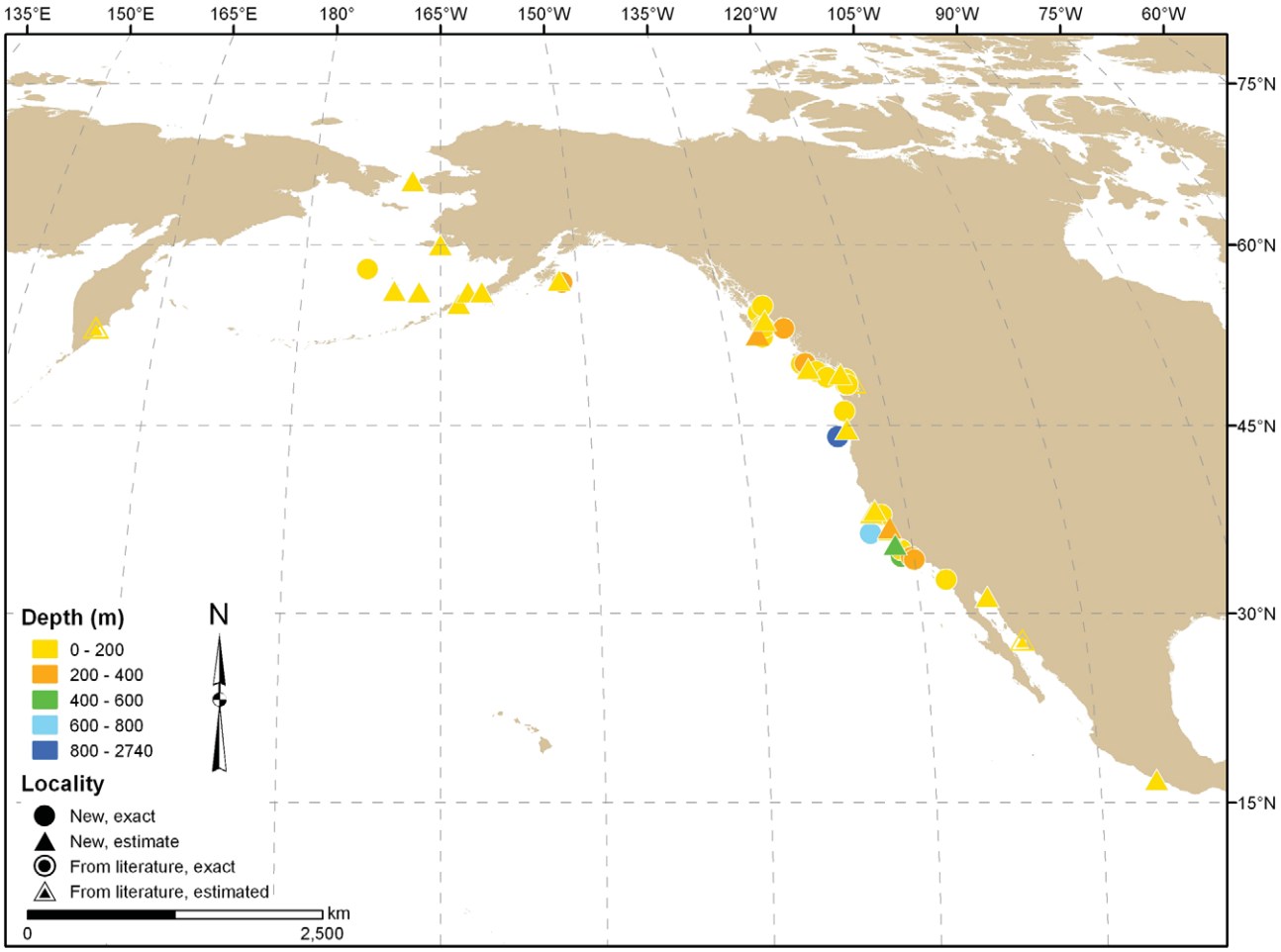

FIGURE 33. Distribution of *Metridium farcimen* from Mexico to Russia.

Family Sagartiidae Gosse, 1858

Genus *Sagartiogeton* Carlgren, 1924

Sagartiogeton californicus (Carlgren, 1940)

(Figures 34–37, Table 5, Appendix 15)
Synonyms: see below

Body form and size. Column ectoderm tan or rose; in most specimens ectoderm sloughed off (likely caused by collection process), exposing mesoglea. Mesoglea of scapulus white, thick (about 1 mm), and cartilaginous; that of scapus thin, and mesenterial insertions and purple endoderm of mesenteries (white in two specimens) apparent. Gametogenic tissue white, and filaments tan to purple. Purple endoderm and white gametogenic tissue make column appear purple and white spotted when ectoderm sloughed off (Figure 34). Sparse cinclides in distal part of scapus and near limbus.

Specimens short (about 3 mm long near mouth, 0.1 mm long at limbus) to approximately as tall as wide (to about 20 mm long), depending on contraction. Pedal disc typically wide; oral disc small and typically hidden along with bases of tentacles below contracted margin of column. Pedal disc circular or slightly oval, to diameter of 47 mm. Oral disc (to about 14 mm diameter) much smaller than pedal disc.

Pedal disc. Pedal disc off-white to tan; in most specimens slightly transparent with mesenterial insertions visible. Wide, concave in most specimens, shape depending on substrate; attached to shells, rocks, or crab exoskeleton. Most specimens with fine debris attached to pedal disc, inferred to be from substrate. Some specimens with gastropod shell embossed on pedal disc.

FIGURE 34. Two specimens of *Sagartiogeton californicus* showing variation in body form (on left SBMNH 83608; on right RBCM 988-00261-029).

TABLE 5. Cnida size and distribution of *Sagartiogeton californicus*. Because cnidae were measured from preserved specimens, the identity of *p*-mastigophores and amastigophores was unclear. * Sparse.

Tissue and Cnida Type	Length x Width (μm)	n	N
Tentacles			
Gracile spirocysts (a)	14.7–37.4 (39.8) x 2.0–4.5 (4.9)	45	3/3
Robust spirocysts (b)	(16.6) 17.8–36.9 x 4.2–7.5 (8.8)	40	3/3
Basitrichs (c)	8.9–13.9 (17.3) x 1.5–2.3	41	3/3
Basitrichs (d)	17.0–29.3 x 2.2–3.2 (3.5)	38	3/3
Microbasic amastigophores (e)	17.9–31.5 x 3.1–5.0	38	3/3
Acontia			
Basitrichs* (f)	11.2–17.3 x 1.7–2.3	23	4/4
Basitrichs (g)	35.8–44.3 x 2.9–4.1	40	4/4
Microbasic amastigophores (h)	55.1–70.1 x (5.2) 5.5–7.1 (7.5)	40	4/4
Actinopharynx			
Basitrichs* (i)	10.5–15.0 x 1.4–2.1	16	3/3
Basitrichs (j)	25.0–34.0 x 2.8–3.2	28	3/3
Microbasic amastigophores (k)	23.9–35.2 x 3.4–5.0	41	3/3
Mesenterial Filaments			
Basitrichs* (l)	9.3–14.8 (15.5) x 1.5–2.3	34	4/4
Microbasic *p*-mastigophores (m)	9.6–14.7 (16.9) x 3.0–4.9	30	3/4
Macrobasic *p*-mastigophores (n)	(35.3) 41.4–61.2 (66.1) x 6.2–9.0	10	1/4
Microbasic amastigophores (o)	(17.2) 18.7–33.0 (34.9) x (3.0) 3.4–5.2(5.9)	48	4/4

Oral disc and tentacles. Oral disc tan and smooth, mesenterial insertions may be visible. Approximately same shape as pedal disc (circular or slightly oval). In most specimens margin contracted so oral disc and bases of inner tentacles not visible.

Mouth approximately half oral disc diameter. Lips purple, slightly raised, radially furrowed. Position of two symmetrical siphonoglyphs evident externally by smaller lips and slightly lighter pigmentation.

About 200 dark purple to white tentacles; ectoderm of outer tentacles typically sloughed away, dark purple endoderm visible through transparent mesoglea. Conical; 1–8 mm long, taper from 0.3–1 mm at base to less than 0.1 mm at tip. Tentacles arrayed in six cycles near margin (fewer tentacles in small specimens). Exocoelic tentacles outermost; shorter than inner (endocoelic) tentacles.

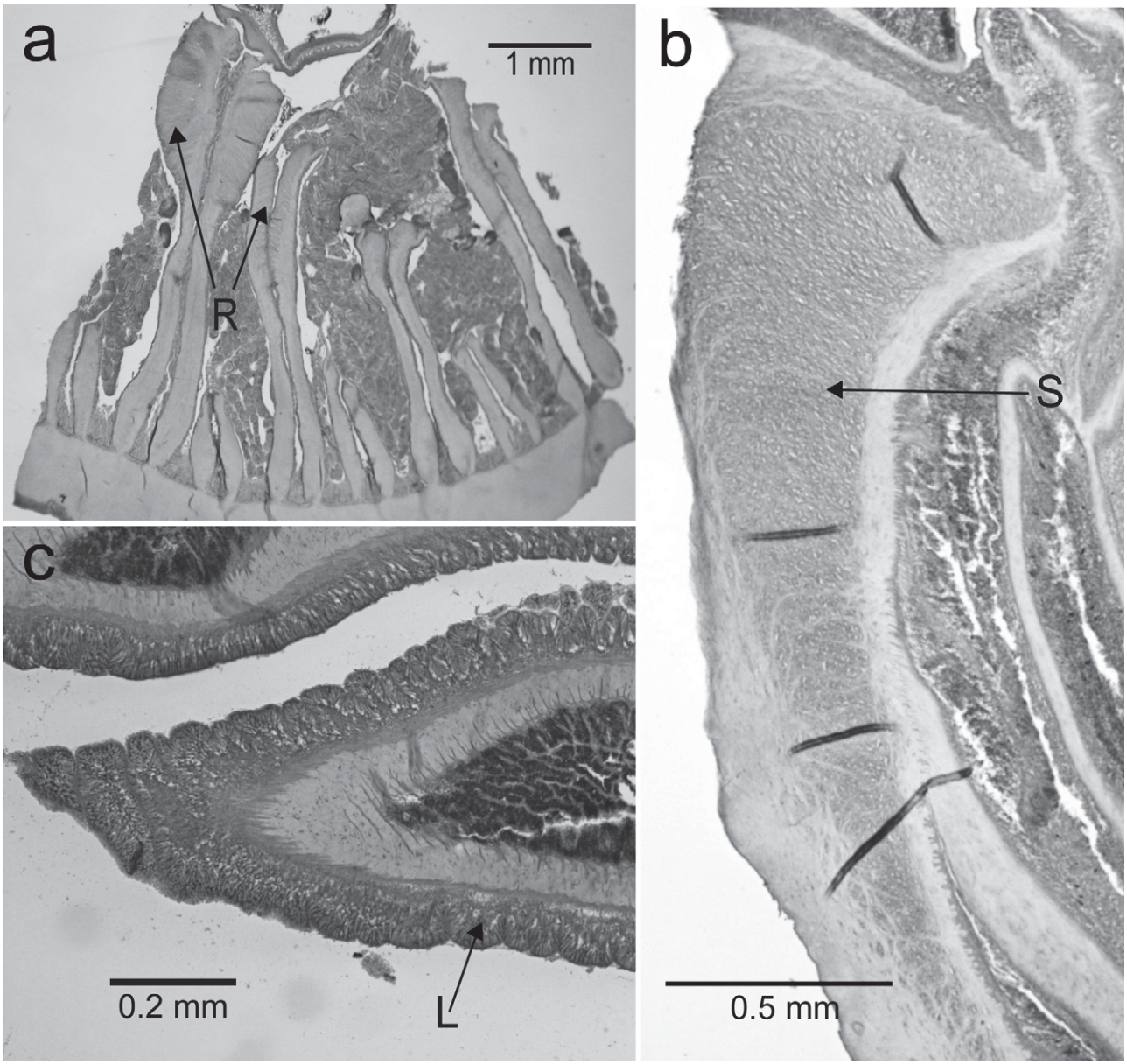

FIGURE 35. *Sagartiogeton californicus*. a. Mesenteries with large diffuse retractor muscles (R); b. well-developed mesogleal retractor muscle (S); c. tentacle with ectodermal longitudinal musculature (L).

Internal anatomy. Actinopharynx dark purple; long in tall specimens, short in flat specimens. Each of two off-white siphonoglyphs attached to pair of directive mesenteries.

Mesenteries typically with purple endoderm (pink to white in some specimens). Arrayed in five cycles; smaller specimens with fewer cycles (three cycles in flat specimen with pedal disc diameter 8 mm). All mesenteries, except some of youngest cycle, with filaments and gametogenic tissue. Mesenteries of first three cycles complete, with central stomata (see Arellano & Fautin 2001). Mesenteries develop from proximal and distal end. Acontia salmon

or off-white with small purple spots. Retractor muscles diffuse, may be lobed; poorly developed in young mesenteries, well developed in old mesenteries (Figure 35a). Parietobasilar muscles not apparent.

Mesogleal marginal sphincter muscle reticular, well developed, occupies most of mesoglea; separated from endoderm by thin strip of mesoglea (Figure 35b). Longitudinal musculature of tentacles ectodermal; circular muscles inferred to be endodermal (Figure 35c).

Cnidae. Gracile and robust spirocysts, basitrichs, microbasic *p*-mastigophores, microbasic amastigophores. Large macrobasic mastigophores (likely macrobasic *p*-mastigophores) were found in clusters in the mesenterial filaments of only one specimen of *S. californicus*; because discharged nematocysts were not observed, we are unable to determine for certain if they are macrobasic amastigophores or *p*-mastigophores. Sizes and distribution of cnidae given in Table 5; cnidae illustrated in Figure 36.

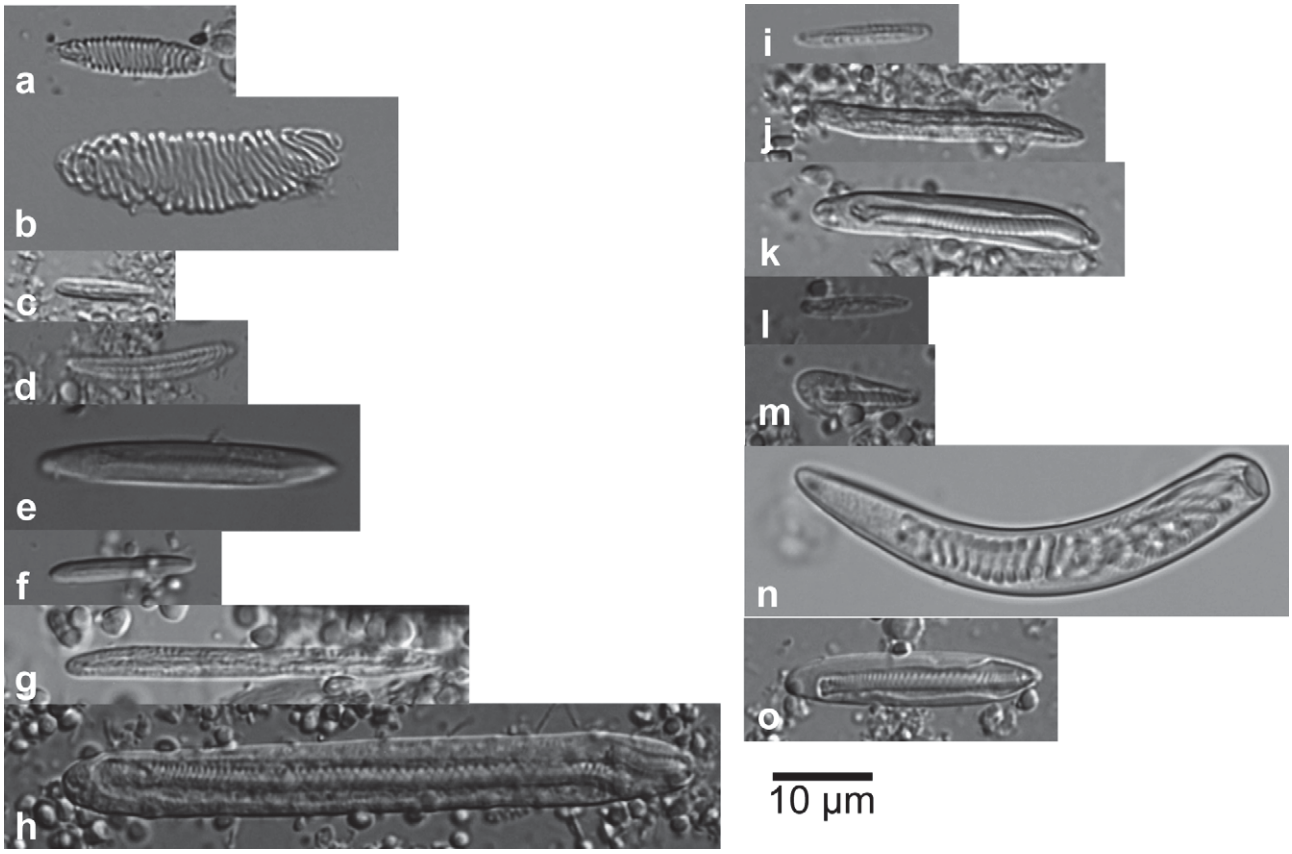

FIGURE 36. Cnidae of *Sagartiogeton californicus*; distribution and dimensions in Table 5. a. Gracile spirocyst; b. robust spirocyst; c. basitrich; d. basitrich; e. microbasic amastigophore; f. basitrich; g. basitrich; h. microbasic amastigophore; i. basitrich; j. basitrich; k. microbasic amastigophore; l. basitrich; m. microbasic *p*-mastigophore; n. macrobasic *p*-mastigophore; o. microbasic amastigophore.

Distribution. *Sagartiogeton californicus* occur from the northeastern Pacific from Mexico to British Columbia from depths of 73 m to at least 1,463 m (Figure 37).

Taxonomic remarks. The original description of *Actinothoë californica* Carlgren, 1940, lacks an illustration of the whole animal and many anatomical details. We were unable to locate specimens upon which Carlgren (1942) based his description in any of the natural history museums that (to our knowledge) have material Carlgren studied; therefore, we designate specimen KUIZ 001451, collected 26-Oct-1997 at 34.89–34.91° N, 122.50–122.49° W, 687 m, as the name-bearing neotype of *S. californicus*. Article 75 of the International Code of Zoological Nomenclature (International Commission on Zoological Nomenclature 1999) stipulates that a neotype is to be designated only if "a name-bearing type is necessary to define the nominal taxon objectively … not as an end in itself, or as a matter of curatorial routine."

The misidentification of specimen USNM 53337 by Cutress as *Sagartiogeton californicus* (below) illustrates the need to designate a neotype to anchor the species concept. The specimen that we designate as the neotype of *Sagartiogeton californicus*, KUIZ 001451, was collected nearest the type locality (27° 04' N, 111° 54' W, 40 fm) of those animals we examined.

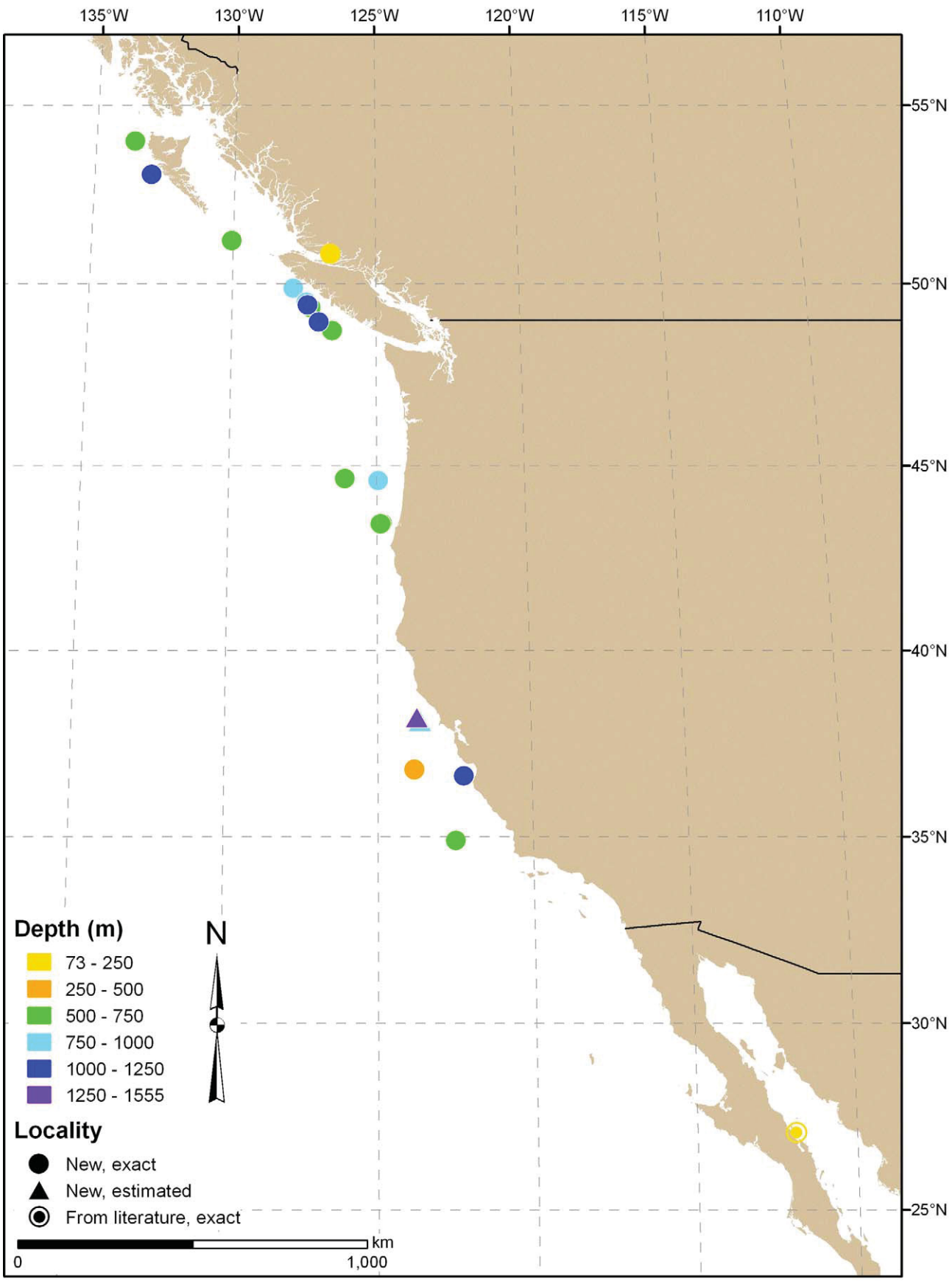

FIGURE 37. Distribution of *Sagartiogeton californicus* from Mexico to British Columbia.

Specimen USNM 53337 differs from the specimens we examined in having a very long, lumpy scapulus with deep longitudinal furrows. It is larger (24 mm long, pedal disc 44 mm wide), and the older mesenteries are less muscular and more lobed than in the specimens Carlgren (1940) described and those we examined. The specimen lacks small basitrichs in the tentacles and possesses two sizes of microbasic amastigophores in the acontia, the smallest approximately 27 µm long. This specimen is clearly a member of family Sagartiidae, but not *Sagartiogeton californicus*.

Carlgren (1949) and Kostina (1988) included both *Actinothoe californica* and *Sagartiogeton californica* in their inventories, seemingly considering them as separate species; both cited Carlgren (1940) as the author of both species, but Carlgren (1940) described only one species belonging to family Sagartiidae.

All of the specimens we examined that are cited in Appendix 15 agree well with published details except that Carlgren (1940) did not find small basitrichs in all tissues. These small nematocysts were sparse and easy to miss in specimens we examined. In addition, Carlgren (1940) reported much smaller microbasic amastigophores and basitrichs of the acontia than we found; however, size of these cnidae in acontia of members of *Sagartiogeton*, the genus into which Carlgren (1949) placed the species, vary greatly from specimen to specimen (Carlgren 1942). Due to similarities in location, depth, and morphology, we have identified as *S. californicus* the specimens that we examined. Although the external anatomy of this species varies, cnidae and internal anatomy of specimens are consistent.

The only other species of *Sagartiogeton* recorded from the Pacific Ocean, *Sagartiogeton erythraios* Zelnio, Rodriguez, and Daly, 2009, occurs in the southwestern Pacific to depths of 2,620 m. It can be distinguished from *S. californicus* by cnidae differences, in having fewer mesenteries and tentacles (3 cycles of mesenteries and 48 tentacles), no cinclides, and a column with a cuticle and papillae. The combination of a reticular marginal sphincter muscle nearly as wide as the mesoglea, retractor muscles that are often lobed, and central stomata differentiate *S. californicus* from *S. erythraios*, and its other congeners, all of which occur in the northern Atlantic Ocean.

Material examined. See Appendix 15.

Differential diagnosis. *Sagartiogeton californicus* can be distinguished from its congeners by its combination of: column with no cuticle or papillae; about 200 tentacles; five cycles of mesenteries; central stomata; cinclides; wide reticular marginal sphincter muscle; retractor muscles that are often lobed.

Discussion

Ten (71%) of the 14 deep-sea species of Actiniaria and Corallimorpharia (sea anemones *sensu lato*) we studied appear endemic to the North Pacific Ocean; however, only the genus *Paraphelliactis* is endemic, and none of the families are. This is the pattern found by Vinogradova (1959) for many deep-sea taxa and Rodríguez *et al.* (2007) for anemones of the Southern Ocean: at the species level animals tend to be confined to one ocean, but at the generic and family levels they are widespread. Of the 13 genera we studied from the northeastern Pacific Ocean, 8 (62%) are also found in the Southern Ocean and 12 (92%) in the Atlantic Ocean. All the families from the northeastern Pacific Ocean are found in the Southern and Atlantic Oceans as well. The deep-sea anemone fauna of the Indian Ocean is too poorly known to be meaningfully compared.

Seven (50%) of the species we identified have been found only in the northeastern Pacific (*Corallimorphus pilatus*, *Corallimorphus denhartogi*, *Anthosactis nomados*, *Bolocera kensmithi* n. sp., *Paraphelliactis pabista*, *Sagartiogeton californicus*, and *Sicyonis careyi* n. sp.). These are the species most likely to be adversely affected if the OMZ spreads. Of the remaining seven, three are also known from the Southern Ocean and likely occur all along the eastern Pacific (*Actinauge verrillii, Bathyphellia australis* and *Actinoscyphia groendyki* n. sp.), one is known from the Atlantic Ocean (*Monactis vestita*), and three are also known from the northwestern Pacific (*Actinostola faeculenta, Liponema brevicorne*, and *Metridium farcimen*).

Species with the widest distributions occur below 2,000 m: *Actinauge verrillii* to 4,250 m, *Actinoscyphia groendyki* n. sp. to at least 3,819 m, *Actinostola faeculenta* to 2,265 m, *Bathyphellia australis* to 4,575 m, *Liponema brevicorne* to 4,134 m, *Metridium farcimen* to 2,740 m, and *Monactis vestita* to 5,320 m.

However, great depth does not always correlate with broad occurrence: *Corallimorphus denhartogi* (to 4,292 m), *Anthosactis nomados* (to 4,325 m), *Bolocera kensmithi* n. sp. (to 4,100 m), *Paraphelliactis pabista* (to 4,100 m), and *Sicyonis careyi* n. sp. (to 3,700 m) appear endemic to the northeastern Pacific. The distribution of

Anthosactis nomados is likely restricted by its symbiosis with the scaphopod *Fissidentalium actiniophorum,* which is known only from the northeastern Pacific (Shimek 1997, White *et al.* 1999). Species that mostly occur above 2,000 m (*Corallimorphus pilatus* from 250 to 2,026 m, and *Sagartiogeton californicus* from 73 to at least 1,463 m) appear endemic to the northeastern Pacific. The growing OMZ poses the biggest threat to the four species endemic to the northeastern Pacific Ocean that occur within the depth range of the OMZ and have restricted geographical ranges (*Corallimorphus pilatus, Anthosactis nomados*, *Sagartiogeton californicus,* and *Sicyonis careyi* n. sp.).

The similarity of deep-sea faunas in all oceans, is most apparent in groups whose members are good dispersers: ostracods, isopods, and nematodes are poor dispersers and typically have limited distributions, whereas foraminiferans have easily transported larvae and are typically widespread (Brandt *et al.* 2007). Future work on dispersal of the deep-sea anemones of the northeastern Pacific may help explain why some species are more widespread than others that occur at similar depths.

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References

Arellano, S.M. & Fautin, D.G. (2001) Redescription and range extension of the sea anemone *Exocoelactis actinostoloides* (Wassilieff, 1908), with revision of genus *Exocoelactis* (Cnidaria, Anthozoa, Actiniaria). *Zoosystema*, 23(4), 645–657.

de Blainville, H.M. (1824) Metridium. *Dictionnaire des Sciences Naturelles. Vol. 30*. F. G. Levrault, Strasbourg, France, 470 pp.

Braby, C.E., Pearse, V.B., Bain, B.A. & Vrijenhoek, R.C. (2009) Pycnogonid-cnidarian trophic interactions in the deep Monterey Submarine Canyon. *Invertebrate Biology*, 128(4), 359–363.

Brandt, A., Gooday, A.J., Brandão, S.N., Brix, S., Brökeland, W., Cedhagen, T., Choudhury, M., Cornelius, N., Danis, B., De Mesel, I., *et al.* (2007) First insights into the biodiversity and biogeography of the Southern Ocean deep sea. *Nature*, 447, 307–311.

Brandt, J.F. (1835) *Prodromus Descriptionis Animalium AB H. Mertensio in Orbis Terrarum Circumnavigatione Observatorum. Vol. 1*. Sumptibus Academiae, Petropoli, 75 pp.

Broecker, W.S. (1991) The great ocean conveyor. *Oceanography*, 4(2), 79–89.

Carlgren, O. (1893) Studien über nordische Actinien. *Kungliga Svenska Vetenskapsakademiens Handlingar*, 25(10), 1–148.

Carlgren, O. (1921) Actiniaria I. *Danish Ingolf-Expedition*, 5, 1–241.

Carlgren, O. (1928a) Actiniaria der Deutschen Tiefsee-Expedition. *Wissenschaftliche Ergebnisse der Deutschen Tiefsee-Expedition auf dem Dampfer "Valdivia" 1898–1899*, 22(4), 125–266.

Carlgren, O. (1928b) Ceriantharier, Zoantharier och Actiniarier. *Meddelelser om Grønland*, supplement 23, 253–308.

Carlgren, O. (1932) Die Ceriantharien, Zoantharien und Actiniarien des arktischen Gebietes. *In*: Römer, F, Schaudinn, F, Brauer, A & Arndt, W (Eds), *Eine Zusammenstellung der arktischen Tierformen mit besonderer Berücksichtigung des Spitzbergen-Gebietes auf Grund der Ergebnisse der Deutschen Expedition in das Nördliche Eismeer im Jahre 1898. Vol 6.* Gustav Fisher, Jena, Germany, pp. 255–266.

Carlgren, O. (1934a) Ceriantharia, Zoantharia and Actiniaria from the "Michael Sars" North Atlantic Deep-sea Expedition 1910. *Report on the Scientific Results of the "Michael Sars" North Atlantic Deep-Sea Expedition 1910*, 5(6), 1–27.

Carlgren, O. (1934b) Zur Revision der Actiniarien. *Arkiv für Zoologi*, 26A(18), 1–36.

Carlgren, O. (1940) Eastern Pacific Expeditions of the New York Zoological Society XIX. Actiniaria from the Gulf of California. *Zoologica*, 25(2), 211–219.

Carlgren, O. (1942) Actiniaria II. *Danish Ingolf-Expedition*, 5(12), 1–92.

Carlgren, O. (1949) A survey of the Ptychodactiaria, Corallimorpharia, and Actiniaria. *Kungliga Svenska Vetenskapsakademiens Handlingar*, 1(1), 1–121.
Carlgren, O. (1951) The actinian fauna of the Gulf of California. *Proceedings of the United States National Museum*, 101, 415–449.
Carlgren, O. (1956) Actiniaria from depths exceeding 6000 meters. *Galathea Reports*, 2, 9–16.
Carney, R.S. & Carey, A.G. (1982) Distribution and diversity of holothuroids (Echinodermata) on Cascadia Basin and Tufts Abyssal Plain. *Deep Sea Research Part A. Oceanographic Research Papers*, 29(5A), 597–607.
Chan, F., Barth, J.A., Lubchenco, J., Kirincich, A., Weeks, H., Peterson, W.T. & Menge, B.A. (2008) Emergence of anoxia in the California Current Large Marine Ecosystem. *Science*, 319, 920.
Cressey, D. (2010) Marine biology: Out of the Blue. *Nature*, 467, 514–515.
Danielssen, D.C. (1890) *Actinida. Den Norske Nordhavs-Expedition 1876-1878. Zoologi*. Grøndahl and Søn, Christiania, Norway, 184 pp.
Deacon, G.E.R. (1982) Physical and biological zonation in the Southern Ocean. *Deep Sea Research Part A. Oceanographic Research Papers*, 29(1), 1–15.
Doumenc, D. (1975) Actinies bathyales et abyssales de l'océan Atlantique nord familles des Hormathiidae (genres *Paracalliactis* et *Phelliactis*) et des Actinostolidae (genres *Actinoscyphia* et *Sicyonis*). *Bulletin du Muséum National d'Histoire Naturelle* (Paris), 197(3), 157–204.
Dunn, D.F. (1982) *Paraphelliactis pabista*, a new species of hormathiid sea anemone from abyssal northeastern Pacific waters (Coelenterata: Actiniaria). *Syesis*, 15, 51–56.
Dunn, D.F. (1983) Some Antarctic and sub-Antarctic sea anemones (Coelenterata: Ptychodactiaria and Actiniaria). *Antarctic Research Series*, 39, 1–67.
Dunn, D.F. & Bakus, G.L. (1977) Redescription and ecology of *Liponema brevicornis* (McMurrich, 1893), with definition of the family Liponematidae (Coelenterata, Actiniaria). *Astarte*, 10, 77–85.
Ekman, S. (1953) *Zoogeography of the Sea*. Sidgwick and Jackson Limited, London, England, 417 pp.
Fautin, D.G. (1984) More Antarctic and Subantarctic sea anemones (Coelenterata: Corallimorpharia and Actiniaria). *Antarctic Research Series*, 41, 1–42.
Fautin, D.G. (1997) Cnidarian reproduction: assumptions and their implications. *In*: den Hartog, J. C. (Ed), *Proceedings of the 6th International Conference on Coelenterate Biology.* Nationaal Natuurhistorisch Museum, Leiden, the Netherlands, pp. 151–162.
Fautin, D.G. (2011) *Hexacorallians of the World*. Available from: http://geoportal.kgs.ku.edu/hexacoral/anemone2/index.cfm [Consulted most recently October 2011].
Fautin, D.G. & Barber, B.R. (1999) *Maractis rimicarivora*, a new genus and species of sea anemone (Cnidaria: Anthozoa: Actiniaria: Actinostolidae) from an Atlantic hydrothermal vent. *Proceedings of the Biological Society of Washington*, 112(3), 624–631.
Fautin, D.G., Bucklin, A. & Hand, C. (1989) Systematics of sea anemones belonging to genus *Metridium* (Coelenterata: Actiniaria), with a description of *M. giganteum* new species. *Wasmann Journal of Biology*, 47(1–2), 77–85.
Fautin, D.G., Daly, M. & Cappola, V. (2005) Sea anemones (Cnidaria: Actiniaria) of the Faroe Islands: a preliminary list and biogeographic context. *Annales Societatis Scientiarum Færoensis*, 41, 77–87.
Fautin, D.G. & Hand, C. (2000) *Metridium farcimen*, the valid name of a common North Pacific sea anemone (Cnidaria: Actiniaria: Acontiaria). *Proceedings of the Biological Society of Washington*, 113(4), 1151–1161.
Fautin, D.G. & Hand, C. (2007) Actiniaria. *In*: Carlton J. T. (Ed), *The Light and Smith Manual: Intertidal Invertebrates from Central California to Oregon. 4th ed.* University of California Press, Los Angeles, California, pp. 134–145.
Fautin, D.G. & Hessler, R.R. (1989) *Marianactis bythios*, a new genus and species of actinostolid sea anemone (Coelenterata: Actiniaria) from the Mariana vents. *Proceedings of the Biological Society of Washington*, 102(4), 815–825.
Fautin, D.G., White, T.R. & Pearson, K.E. (2002) Two new species of deep-water Corallimorpharia (Cnidaria: Anthozoa) from the northeast Pacific, *Corallimorphus denhartogi* and *C. pilatus*. *Pacific Science*, 56(2), 113–124.
Gewin, V. (2010) Dead in the water. *Nature*, 466, 812–814. doi:10.1038/466812a.
Gosse, P.H. (1858) Synopsis of the families, genera, and species of the British *Actiniae*. *Annals and Magazine of Natural History*, 1, 414–419.
Gosse, P.H. (1860) *A History of the British Sea-Anemones and Corals.* Van Voorst, London, England, 362 pp.
Gotshall, D. (1994) *Guide to Marine Invertebrates: Alaska to Baja California*. Sea Challengers, Monterey, California, 112 pp.
Gravier, C. (1918) Note préliminaire sur les hexactiniaires recueillis au cours des croisières de la *Princesse-Alice* et de l'*Hirondelle* de 1888 à 1913 inclusivement. *Bulletin de l'Institut Océanographique (Monaco)*, 346, 1–24.
Häussermann, V. (2004) The sea anemone genus *Actinostola* (Verrill 1883): variability and utility of traditional taxonomic features, and a re-description of *Actinostola chilensis* (McMurrich 1904). *Polar Biology*, 28, 26–38.
Häussermann, V. (2005) The sea anemone genus *Actinostola* Verrill 1883: variability and utility of traditional taxonomic features, and a re-description of *Actinostola chilensis* McMurrich 1904. *Polar Biology*, 28, 338-350.
Hand, C. (1956, for 1955) The sea anemones of central California Part III. The acontiarian anemones. *Wasmann Journal of Biology*, 13(2), 189–251.
Hertwig, R. (1882) *Die Actinien der Challenger Expedition*. Gustav Fischer, Jena, Germany, 119 pp.
Hertwig, R. (1888) Report on the Actiniaria dredged by H.M.S. Challenger during the years 1873–1876 [Supplement]. *Report on the Scientific Results of the Voyage of the H.M.S. Challenger during the years 1873–76 (Zoology),* 26(3), 1–56.
Humason, G.L. (1967) *Animal Tissue Techniques*. W.H. Freeman, San Francisco, California, 569 pp.
International Commission on Zoological Nomenclature (1999) *International Code of Zoological Nomenclature. 4th ed.* The

International Trust for Zoological Nomenclature, London, United Kingdom, 306 pp.
Johnston, G. (1832) Illustrations in British Zoology. *Magazine of Natural History*, 5, 163–164.
Kostina, E.E. (1988) Biogeographical characteristics of sea anemones of the Pacific boreal region [in Russian with English abstract]. *Biologiya Morya*, 3, 14–21.
Kramer, A. & Francis, L. (2004) Predation resistance and nematocyst scaling for *Metridium senile* and *M. farcimen*. *Biological Bulletin*, 207, 130–140.
Linnaeus, C. (1761) *Fauna Svecica*. Laurentii Salvii, Stockholm, Sweden, 578 pp.
McCauley, J.E. & Carey, A.G. (1967) Echinoidea of Oregon. *Journal of the Fisheries Research Board of Canada*, 24(6), 1385–1401.
McMurrich, J.P. (1893) Report on the Actiniae collected by the United States Fish Commission Steamer Albatross during the winter of 1887–1888. *Proceedings of the United States National Museum*, 16(930), 119–216.
McMurrich, J.P. (1904) The Actiniae of the Plate collection. *Zoologische Jahrbucher*, 6[suppl], 215-306.
Milne-Edwards, H. & Haime, J. (1849) Recherches sur les polypiers, cinquiéme mémoire. Monographie des oculinides. *Annales des Sciences Naturelles*, 13, 63–110.
Moseley, H.N. (1877) On new forms of *Actiniaria* dredged in the deep sea; with a description of certain pelagic surface-swimming species. *Transactions of the Linnean Society (London)*, 1, 295–305.
National Geophysical Data Center, National Oceanic and Atmospheric Administration, U.S. Dept. of Commerce (2006) *ETOPO2v2 Global Gridded 2-minute Database*. Available from: http://www.ngdc.noaa.gov/mgg/global/etopo2.html [Consulted most recently Dec. 2010].
Pax, F. (1909) Die Aktinien der ostafrikanischen Inseln. *In*: Voeltzkow, A. (Ed), *Reise in Ostafrika in den Jahren 1903–1905*. 2: pp. 399–418.
Pax, F. (1922) Diagnosen neuer Actiniarien aus der Ausbeute der Deutschen (1901–1903) und der Französischen (1908–1910) Südpolar-Expedition. *Zoologischer Anzeiger*, 54(3/4), 72–92.
Rafinesque, C.S. (1815) *Analyse de la Nature ou Tableau de l'Univers et des Corps Organisés*. C. S. Rafinesque, Palerme, Italy, 224 pp.
Riemann-Zürneck, K. (1973) Actiniaria des Südwestatlantik. I. Hormathiidae. *Helgoländer Wissenschaftliche Meeresuntersuchungen*, 25, 273–325.
Riemann-Zürneck, K. (1978) Actiniaria des Südwestatlantik. IV. *Actinostola crassicornis* (Hertwig, 1882) mit einer Diskission verwandter Arten. *Helgoländer Wissenschaftliche Meeresuntersuchungen*, 25, 273–325.
Riemann-Zürneck, K. (1986) On some abyssal sea anemones of the North Atlantic (Actiniaria: Hormathiidae). *Mitteilungen aus dem Hamburgischen Zoologischen Museum Institut*, 83, 7–29.
Riemann-Zürneck, K. (1991) A new species of *Sicyonis* (Actiniaria: Actinostolidae) from the abyssal NE Atlantic. *Mitteilungen aus dem Hamburgischen Zoologischen Museum Institut*, 88, 7–15.
Riemann-Zürneck, K. (1994) Taxonomy and ecological aspects of the Subarctic sea anemones *Hormathia digitata*, *Hormathia nodosa*, and *Allantactis parasitica* (Coelenterata, Actiniaria). *Ophelia*, 39(3), 197–224.
Riemann-Zürneck, K. (1997) The deep-sea anemones *Bathyphellia margaritacea* and *Daontesia porcupina* sp. nov. with comments on the family Bathyphelliidae. *Journal of the Marine Biological Association of the United Kingdom*, 77, 361–374.
Rodríguez, E., López-González, P.J. & Gili, J.M. (2007) Biogeography of Antarctic sea anemones (Anthozoa: Actiniaria): what do they tell us about the origin of the Antarctic benthic fauna? *Deep-Sea Research Part II*, 54, 1876–1904.
Sanamyan, N.P., Cherniaev, E.S. & Sanamyan, K.E. (2009) *Bathyphellia margaritacea* (Cnidaria: Actiniaria): the most northern species in the world. *Polar Biology*, 32, 1245–1250.
Sanamyan, N.P. & Sanamyan, K.E. (2007) Deep-water Actiniaria from East Pacific hydrothermal vents and cold seeps. *Invertebrate Zoology*, 4(1), 83–102.
Shimek, R.L. (1997) A new species of eastern Pacific *Fissidentalium* (Mollusca: Scaphopoda) with a symbiotic sea anemone. *Veliger*, 40(2), 178–191.
Simon, J.A. (1892) *Ein Beitrag zur Anatomie und Systematik der Hexactinien*. Druck von Val. Hvfling, München, Germany, 106 pp.
Smith, K.L., Kaufmann, R.S. & Baldwin, R.J. (1994) Coupling of near-bottom pelagic and benthic processes at abyssal depths in the eastern North Pacific Ocean. *Limnology and Oceanography*, 39(5), 1101–1118.
Stephenson, T.A. (1918) On certain Actiniaria collected off Ireland by the Irish Fisheries Department, during the years of 1899–1913. *Proceedings of the Royal Irish Academy*, 34B(7), 106–164.
Stephenson, T.A. (1920) On the classification of Actiniaria. Part I. -- Forms with acontia and forms with a mesogloeal sphincter. *Quarterly Journal of Microscopical Science*, 64(256), 425–574.
Studer, T. (1879) Zweite Abtheilung der *Anthozoa polyactinia*, welche während der Reise S. M. S. Corvette Gazelle um die Erde gesammelt wurden. *Monatsberichte der könglich preussischen Akademie der Wissenschaften zu Berlin*, 1878, 524–550.
Tilesius, G. T. (1809) De nova Actiniarum specie gigantean, Kamtschatica. *Memoires de l'Académie Impériale des Sciences de St. Pétersbourg*, 1, 388–422.
Verrill, A.E. (1882) Notice of the remarkable marine fauna occupying the outer banks off the southern coast of New England, No. 4. *American Journal of Science and Arts*, 23, 216–225.
Verrill, A.E. (1883) Reports on the Anthozoa, and on some additional species dredged by the "Blake" in 1877–1879, and by the U. S. Fish Commission Steamer "Fish Hawk" in 1880–82. *Bulletin of the Museum of Comparative Zoology (Harvard University)*, 11(1), 1–72.

Vinogradova, N.G. (1959) The zoogeographical distribution of the deep-water bottom fauna in the abyssal zone of the ocean. *Deep-Sea Research*, 5, 205–208.
White, T.R., Wakefield Pagels, A.K. & Fautin, D.G. (1999) Abyssal sea anemones (Cnidaria: Actiniaria) of the northeast Pacific symbiotic with molluscs: *Anthosactis nomados*, a new species, and *Monactis vestita* (Gravier, 1918). *Proceedings of the Biological Society of Washington*, 112(4), 637–651.
Zamponi, M.O. & Acũna, F. H. (1992) Sobre las caracteristicas gonadales de *Monactis vestita* (Gravier, 1918), Sensu Riemann-Zürneck, 1986 (Actiniaria, Hormathiidae). *Iheringia (Porte Alegre)*, 72, 151–152.
Zelnio, K.A., Rodriguez, E. & Daly, M. (2009) Hexacorals (Anthozoa: Actiniaria, Zoanthidea) from hydrothermal vents in the south-western Pacific. *Marine Biology Research*, 5, 547–571.

APPENDIX 1. Sources of locality information.

1	Specimens examined in this study	**11**	Sanamyan and Sanamyan 2007
2	Fautin *et al.* 2002	**12**	Dunn 1982
3	Fautin 1984	**13**	Dunn and Bakus 1977
4	White *et al.* 1999	**14**	Braby *et al.* 2009
5	McMurrich 1893	**15**	Carlgren 1951
6	Dunn 1983	**16**	Fautin *et al.* 1989
7	Fautin 1997	**17**	Kramer and Francis 2004
8	Riemann-Zürneck 1986	**18**	Brandt 1835
9	Gravier 1918	**19**	Tilesius 1809
10	Fautin *et al.* 2005	**20**	Carlgren 1940

APPENDIX 2. Localities of *Corallimorphus denhartogi.*

Locality (Lat. or description)	Locality (Long. or description)	Depth (m)	Collection Date	Repository	Catalog Number	Type Status	Number of Specimens	Source
31.40 to 31.47	-120.24 to -120.17	3880	--	SIO	Co 1388	P	1	2
34.07	-123.18	4100	Feb-1990	KUIZ	001391	H	1	1,2
34.63	-123.02	4100	22-Jul-1992	KUIZ	001607	--	2	1
34.64	-123.49	2975–3010	--	USNM	1000047	P	2	2
34.65	-123.97	4100	17-Jun-1994	KUIZ	001598	--	5	1
34.67	-123.05	4100	1-May-1995	KUIZ	001555	--	1	1
34.67	-123.18	4100	9-Jun-1995	KUIZ	001551	--	2	1
″	″	″	3-Jun-1995	KUIZ	001556	--	1	1
″	″	″	5-Jun-1996	KUIZ	001558	--	4	1
″	″	″	22-Sep-1994	KUIZ	001599	--	2	1
″	″	″	22-Jul-1991	RBCM	001-00046-001	P	1	1,2
34.68	-123.08	4100	5-Feb-1994	KUIZ	001606	--	3	1
34.68	-123.13	4100	30-Oct-1989	KUIZ	002166	--	4	1
34.70	-123.13	4100	7-Nov-1993	KUIZ	001549	--	2	1
34.70	-123.15	4100	14-Feb-1995	KUIZ	001554	--	5	1
″	″	″	″	CAS	146043	P	1	1,2
34.70	-123.23	4100	22-Oct-1994	KUIZ	001609	--	1	1
34.72	-123.12	4100	1-Aug-1991	KUIZ	001553	--	2	1
34.72	-123.18	4100	17-Feb-1996	KUIZ	001547	--	2	1
″	″	″	18-Feb-1990	KUIZ	001548	--	1	1
34.72	-123.23	4100	9-Oct-1996	KUIZ	001552	--	2	1
″	″	4134	12-Oct-1996	KUIZ	001600	--	2	1
34.73	-123.12	4100	22-Jul-1991	KUIZ	001601	--	3	1
34.73	-123.13	4100	24-Jun-1990	KUIZ	001602	--	1	1
34.75	-123.03	4100	24-Feb-1993	KUIZ	001608	--	1	1
34.75	-123.07	4100	21-Oct-1991	KUIZ	001550	--	7	1
34.75	-123.12	4100	24-Jun-1991	KUIZ	001605	--	1	1
34.77	-123.10	4100	20-Feb-1991	KUIZ	001603	--	1	1
34.77	-123.13	4100	17-Oct-1992	KUIZ	001604	--	4	1
34.78	-123.12	4134	--	RMNH	24967	P	1	2
″	″	″	12-Jun-1992	KUIZ	001557	--	5	1
36.27	-123.61	2820–2960	1-Mar-1992	KUIZ	001528	P	4	1,2
37.07	-123.41	3175–3180	29-Feb-1992	CAS	154362	P	1	1,2
37.37 to 37.27	-123.90 to -123.88	3592–3798	--	SIO	Co 2001	--	3	2
37.64	-123.47	2945–3075	--	MLML	C 0193	P	1	2
37.73	-123.12	4100	--	USNM	100903	P	1	2
40.37	-127.50	4250	--	SBMNH	144411	P	1	1,2
44.05	-125.40	2938	15-Jun-1972	SBMNH	211944	--	2	1
44.72	-127.38	3021	12-Jun-1974	SBMNH	144410	P	2	1,2
44.73	-124.50	4292	24-Jul-1967	SBMNH	211943	--	1	1
″	″	″	″	SBMNH	211946	--	1	1
44.76	-127.40	2790	22-Oct-1965	SBMNH	211945	--	1	1
--	--	3050–3056	12-Apr-2009	KUIZ	003298	--	2	1

APPENDIX 3. Localities of *Corallimorphus pilatus.*

Locality (Lat. or description)	Locality (Long. or description)	Depth (m)	Collection Date	Repository	Catalog Number	Type Status	Number of Specimens	Source
32.93 to 32.85	-117.62 to -117.60	896	--	SIO	Co 2009	P	2	2
USA: California: off Monterey Bay		1034–1107	18-Nov-1975	CAS	71108	--	1	1
36.76	-121.97	490	2-Apr-1998	KUIZ	001392	P	1	1,2
″	″	″	″	KUIZ	001393	P	1	1,2
45.88	-124.90	840	3-Apr-1967	SBMNH	144409	P	2	2
48.37 to 48.38	-126.46 to -126.47	1416–1433	29-Aug-2001	RBCM	010-00168-001	--	1	1
48.41	-126.10	274	--	CAS	69283	--	3	1
48.43 to 48.40	-126.14 to -126.14	315	23-Feb-1988	RBCM	988-00258-008	P	1	1,2
48.44	-126.34	1092	Feb-1972	CAS	69281	--	2	1
48.89	-126.91	900	--	KUIZ	001394	P	1	1,2
″	″	″	--	CAS	152514	P	1	1,2
″	″	″	--	USNM	100904	P	1	1
48.89 to 48.96	-126.91 to -126.90	900	28-Feb-1988	RBCM	001-00044-001	H	1	1,2
″	″	″	″	RBCM	988-00268-034	--	7	1,2
″	″	″	″	RBCM	988-00268-042	--	10	1
49.13	-127.00	513–525	30-Jul-1999	RBCM	003-00010-003	--	1	1
49.17 to 49.19	-127.07 to -127.09	526–569	5-Apr-2003	KUIZ	003256	--	2	1
55.55	-133.63	1921	Aug-1965	CAS	71091	--	7	1
55.71	-134.75	2026 [1108 fm]	4-Sep-1965	CAS	69292	--	2	1
USA: Alaska: Gulf of Alaska		340	26-Jul-2001	CAS	175088	--	3	1

APPENDIX 4. Localities of *Bolocera kensmithi* n. sp. *Specimens from which cnidae measurements were made.

Locality (Lat. or description)	Locality (Long. or description)	Depth (m)	Collection Date	Repository	Catalog Number	Type Status	Number of Specimens	Source
34.67	-123.18	4100	22-Sep-1994	KUIZ	001512	--	2	1
″	″	″	3-Jun-1995	KUIZ	001518	--	1	1
″	″	″	5-Jun-1996	CAS	184529	P	4	1
″	″	″	12-Oct-1996	KUIZ	003326	--	2	1
34.68	-123.13	4100	30-Oct-1989	KUIZ	002169	--	1	1
34.68	-123.18	4100	10-Feb-1994	KUIZ	001509	--	1	1
34.70	-123.03	4100	14-Nov-1995	USNM	1149361*	P	1	1
34.70	-123.13	4100	7-Nov-1993	KUIZ	001507	--	1	1
34.70	-123.15	4100	1-May-1995	KUIZ	001515	--	2	1
34.72	-123.12	4100	1-Aug-1991	KUIZ	001496*	--	3	1
34.72	-123.22	4100	29-Jan-1996	KUIZ	001522*	P	1	1
34.75	-123.03	4100	24-Feb-1995	KUIZ	001504	--	2	1
34.75	-123.07	4100	21-Oct-1991	KUIZ	001498	--	1	1
34.77	-123.13	4100	17-Oct-1992	SBMNH	149659*	P	1	1
34.78	-123.07	4100	26-Feb-1992	KUIZ	001501	--	1	1
49.35 to 49.33	-127.55 to -127.52	1804–1827	6-Apr-2003	KUIZ	003252*	H	1	1
49.71 to 49.71	-127.95 to -127.96	2003–2091	15-Apr-2003	RBCM	010-00573-001*	P	1	1
50.02 to 50.03	-128.85 to -128.86	2025	7-Oct-2006	RBCM	010-00186-002	--	7	1

APPENDIX 5. Localities of *Actinoscyphia groendyki* n. sp. *Specimens from which cnidae measurements were made.

Locality (Lat. or description)	Locality (Long. or description)	Depth (m)	Collection Date	Repository	Catalog Number	Type Status	Number of Specimens	Source
-77.55 to -77.52	-163.03 to -163.08	606–638	5-Feb-1968	CAS	28764	--	1	1,3
-60.03 to -59.92	-49.23 to -49.23	3819–3876	7-Mar-1963	CAS	28763	--	1	1,3
-59.98 to -59.97	-70.72 to -70.53	2782–2827	--	USNM	60677	--	1	3
-57.38	-26.57	2248–2402	26-May-1975	CAS	28765	--	2	1,3
-56.49	-26.78	2248–2387	30-May-1975	CAS	29628	--	1	1,3
-56.49	-28.02	2384–2402	--	USNM	60695	--	3	3
-56.07 to -56.00	-33.98 to -33.95	3138–3239	--	USNM	60674	--	3	3
-56.06	-26.97	2128–2161	3-Jun-1975	CAS	29627	--	1	1,3
-55.25 to -55.30	-58.92 to -58.97	3514–3642	5-Dec-1962	CAS	29629	--	3	1,3
-54.00 to -54.08	-33.67 to -33.72	2663–2718	--	USNM	60676	--	1	3
-53.22 to -53.27	-75.68 to -75.68	1500–1666	--	USNM	60675	--	1	3
USA: California: San Clemente Basin		1880–1845	14-Jan-1985	CAS	95889	--	--	1
43.27	-125.84	3000	27-Jul-1965	SBMNH	422588	--	19	1
43.72	-125.48	2997	17-Jun-1972	SBMNH	422618	--	13	1
43.73	-125.43	3000	17-Jun-1972	SBMNH	422612	--	9	1
43.74	-125.43	2992	16-Jun-1972	SBMNH	422610	--	12	1
USA: Oregon		2808	21-Nov-1964	CAS	160270	--	5	1
″		2850	30-Apr-1996	CAS	110755	--	1	1
″		2853	21-Aug-1965	CAS	69287	--	1	1
44.05	-125.39	2938	15-Jun-1972	SBMNH	422567	--	85	1
″	″	″	″	SBMNH	422628	--	37	1
44.10	-125.38	2740	14-Jun-1972	SBMNH	422568	--	73	1
44.11	-125.41	2938	15-Jun-1972	SBMNH	422566	--	148	1
44.38	-125.58	2878	4-Aug-1974	SBMNH	422621	--	11	1
44.40	-125.59	2893	4-Aug-1974	SBMNH	83596	--	24	1
44.47	-125.54	2800	13-Jan-1965	SBMNH	422652	--	6	1
44.49	-126.48	2772	23-Oct-1965	SBMNH	422620	--	9	1
44.50	-125.40	2772	9-Apr-1965	SBMNH	422572	--	12	1
44.52	-125.59	2736	2-Oct-1965	CAS	69288	--	2	1
44.52 to 44.56	-125.70 to -125.69	2926	29-Jul-1965	SBMNH	422639	--	1	1
44.55 to 44.53	-125.59 to -125.59	2810	27-Mar-1966	SBMNH	422647	--	5	1
44.55	-126.95	2736	8-Feb-1965	CAS	69286	--	1	1
44.55	-128.32	2820	3-Nov-1973	SBMNH	422649	--	7	1
44.56	-124.93	2520	25-Jul-1967	SBMNH	211978	--	5	1
44.56	-125.57	2809	14-Oct-1966	SBMNH	211924	--	18	1
44.58	-125.57	2807	15-Jul-1968	SBMNH	422650	--	1	1
44.58	-125.66	2862	17-Jul-1968	SBMNH	422636	--	1	1
44.58	-128.36	2826	3-Nov-1973	SBMNH	422569	--	50	1
44.59	-125.59	1900	15-Jul-1968	SBMNH	211925	--	1	1

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APPENDIX 5. (Continued)

Locality (Lat. or description)	Locality (Long. or description)	Depth (m)	Collection Date	Repository	Catalog Number	Type Status	Number of Specimens	Source
"	"	2816	16-Mar-1970	SBMNH	422576	--	43	1
44.61	-125.63	2772	17-Jun-1964	SBMNH	422602	--	2	1
44.61	-126.13	3000	30-Dec-1963	SBMNH	422643	--	7	1
44.61	-127.32	3030	12-Jun-1974	SBMNH	422642	--	40	1
44.63	-125.67	2816	15-Mar-1970	SBMNH	422608	--	13	1
"	"	2800	16-Mar-1970	SBMNH	211923	--	11	1
44.64	-126.62	2850	20-Feb-1971	SBMNH	422585	--	17	1
44.64	-126.92	2806	23-Oct-1965	SBMNH	422637	--	5	1
44.65	-125.50	2800	29-Mar-1969	SBMNH	422581	--	47	1
44.66	-126.08	2794	23-Oct-1965	SBMNH	422648	--	3	1
44.66	-125.57	2800	10-Jan-1967	SBMNH	422640	--	3	1
44.67	-125.68	2850	29-Dec-1964	SBMNH	422597	--	6	1
44.67	-128.19	2700	22-Oct-1965	SBMNH	422631	--	3	1
44.67	-128.43	2994	2-Nov-1973	SBMNH	422634	--	3	1
44.68	-125.59	2800	14-Jan-1968	CAS	69289	--	1	1
"	"	"	"	SBMNH	422629	--	25	1
44.68	-125.62	2800	26-Jul-1967	SBMNH	211922	--	20	1
44.69	-125.60	2779	6-Oct-1969	SBMNH	144413	--	39	1
44.71	-125.53	2825	6-Oct-1969	SBMNH	422570	--	114	1
44.72	-127.38	3021	12-Jun-1974	SBMNH	422592	--	16	1
44.73	-124.50	2510	31-Oct-1967	SBMNH	211926	--	11	1
44.73	-127.46	2803	2-Feb-1973	SBMNH	422589	--	29	1
44.74	-125.62	2830	28-Mar-1969	SBMNH	422591	--	11	1
44.74	-127.43	2749	2-Feb-1973	SBMNH	422614	--	18	1
44.74	-127.48	2818	3-Feb-1973	SBMNH	422625	--	23	1
44.75	-125.99	2800	1-Dec-1965	CAS	69290	--	5	1
44.75	-126.50	2787	19-Jan-1970	SBMNH	422578	--	19	1
44.76	-127.40	2790	22-Oct-1965	SBMNH	422594	--	6	1
44.82	-125.66	2810	29-Oct-1967	SBMNH	144408	--	11	1
"	"	"	"	SBMNH	422633	--	14	1
44.83	-125.58	2743	8-Mar-1972	SBMNH	422586	--	12	1
44.89	-126.51	2770	18-Jan-1970	SBMNH	422590	--	8	1
"	"	"	"	SBMNH	422600	--	4	1
44.89	-126.51	2770	18-Jan-1970	SBMNH	423132	--	8	1
44.91	-126.58	2774	19-Jan-1970	SBMNH	422638	--	12	1
44.92	-127.47	2838	4-Nov-1973	SBMNH	422619	--	23	1
44.96	-126.62	2770	19-Feb-1971	SBMNH	422617	--	16	1
44.97	-125.74	2790	19-Mar-1970	SBMNH	422632	--	12	1
44.97	-126.60	2795	18-Feb-1971	SBMNH	422646	--	14	1
44.99	-126.66	2770	19-Feb-1971	SBMNH	149661*	H	1	1

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APPENDIX 5. (Continued)

Locality (Lat. or description)	Locality (Long. or description)	Depth (m)	Collection Date	Repository	Catalog Number	Type Status	Number of Specimens	Source
″	″	″	″	SBMNH	149662	P	2	1
″	″	″	″	KUIZ	003350*	P	1	1
″	″	″	″	SBMNH	422635*	--	4	1
45.00	-127.49	2884	5-Nov-1973	SBMNH	422575	--	33	1
45.03	-127.52	2850	5-Nov-1973	SBMNH	422574	--	38	1
45.04	-127.54	2838	5-Nov-1973	SBMNH	422626	--	28	1
45.15	-125.64	2669	15-Jul-1969	SBMNH	422601	--	1	1
45.20	-127.54	2809	14-Mar-1973	SBMNH	422579	--	26	1
45.28	-126.65	2721	18-Jan-1970	SBMNH	422644	--	19	1
45.29	-126.47	2710	18-Feb-1971	KUIZ	003351*	P	1	1
″	″	″	″	USNM	1149362	P	1	1
″	″	″	″	CAS	184531	P	1	1
″	″	″	″	RBCM	010-00571-001	P	1	1
″	″	″	″	SBMNH	144417	--	14	1
45.30	-125.67	2633	5-Oct-1969	SBMNH	422605	--	1	1
45.30	-125.79	2605	18-Mar-1970	SBMNH	422604	--	1	1
45.34	-126.60	2750	17-Feb-1971	SBMNH	422624	--	13	1
45.36	-127.55	2800	18-May-1971	SBMNH	422622	--	27	1
45.38	-127.61	2798	18-May-1971	SBMNH	422641	--	7	1
45.40	-127.65	2811	18-May-1971	SBMNH	422607	--	23	1
45.45	-127.48	2743	3-Feb-1973	SBMNH	422577	--	30	1
45.53	-127.47	2780	3-Feb-1973	SBMNH	422615	--	15	1
45.64	-126.69	2670	16-Feb-1971	SBMNH	422623	--	11	1
45.64	-126.80	2721	17-Feb-1971	SBMNH	422616	--	12	1
45.65	-125.81	2425	19-Mar-1970	SBMNH	422593	--	1	1
45.73	-125.45	2225	14-Jul-1969	SBMNH	422606	--	1	1
45.77	-126.72	2675	16-Jan-1970	SBMNH	422630	--	1	1
45.78	-126.59	2665	15-Feb-1971	SBMNH	422645	--	17	1
45.84	-126.48	2651	17-Jan-1970	SBMNH	422611	--	24	1
45.88	-126.65	2666	16-Jan-1970	SBMNH	422598	--	7	1
45.92	-127.58	2765	17-May-1971	SBMNH	422573	--	26	1
45.93	-126.60	2670	15-Feb-1971	SBMNH	422599	--	3	1
45.94	-125.70	2195	30-Mar-1969	SBMNH	422595	--	1	1
45.94	-127.61	2761	17-May-1971	SBMNH	422613	--	13	1
45.94	-127.64	2763	13-Mar-1973	SBMNH	422571	--	21	1
45.95	-127.55	2763	11-Mar-1973	SBMNH	422582	--	32	1
45.96	-126.63	2743	14-Feb-1971	SBMNH	422627	--	30	1
46.03	-127.53	2740	12-Mar-1973	SBMNH	422580	--	27	1
46.04	-126.56	2706	15-Feb-1971	SBMNH	422596	--	1	1
46.08	-125.58	2156	3-Oct-1969	SBMNH	422603	--	2	1
USA: Alaska: Aleutian Islands		1039	30-Jun-2004	CAS	180914	--	2	1
52.08 to 52.09	-131.53 to -131.52	1460	5-Aug-2004	RBCM	010-00216-004	--	2	1
52.77	-132.61	1330	14-Oct-2006	RBCM	010-00192-001	--	1	1
53.06	-132.98	1225–1240	21-Mar-1991	RBCM	991-00332-058	--	6	1

APPENDIX 6. Localities of *Anthosactis nomados.*

Locality (Lat. or description)	Locality (Long. or description)	Depth (m)	Collection Date	Repository	Catalog Number	Type Status	Number of Specimens	Source
34.65	-122.97	4100	17-Jun-1994	KUIZ	001026	--	6	1
34.67	-123.05	4100	1-May-1995	KUIZ	001030	--	4	1
34.67	-123.13	4100	12-Oct-1996	KUIZ	001559	--	2	1
″	″	″	9-Oct-1996	KUIZ	001561	--	4	1
″	″	″	″	KUIZ	001562	--	2	1
34.67	-123.18	4100	22-Sep-1994	KUIZ	001027	--	7	1
″	″	″	--	KUIZ	001031	--	9	1
″	″	″	9-Jun-1995	KUIZ	001032	--	3	1
″	″	″	5-Jun-1996	KUIZ	001564	--	9	1
″	″	″	31-May-1996	KUIZ	001565	--	15	1
34.68	-123.18	4000	4-Feb-1994	USNM	96574	P	1	4
USA: California: ~34.7°, -123.0°		4100	--	KUIZ	001020	--	1	1
″		″	--	KUIZ	001021	--	1	1
″		″	--	KUIZ	001022	--	1	1
″		″	--	KUIZ	001024	--	18	1
″		″	--	KUIZ	001025	--	2	1
″		″	--	KUIZ	001029	--	3	1
34.70	-123.13	4100	7-Nov-1993	KUIZ	001019	H	1	1,4
34.70	-123.23	4100	22-Oct-1994	KUIZ	001028	--	11	1
34.72	-123.10	4100	19-Jul-1993	RBCM	996-00024-001	P	1	1,4
″	″	″	1-May-1995	RBCM	996-00025-001	P	1	1,4
34.72	-123.23	4100	12-Oct-1996	KUIZ	001563	--	5	1
34.75	-123.03	4100	24-Feb-1993	SBMNH	143214	P	1	4
34.75	-123.07	4100	21-Oct-1994	KUIZ	001023	--	1	1
34.77	-123.13	4100	17-Oct-1992	CAS	106264	P	1	1,4
″	″	″	″	LACM	92-113.1	P	1	4
34.82 to 34.85	-123.21 to -123.25	4080	--	KUIZ	002172	--	2	1
39.55	-127.30	4325	6-Jan-1983	SBMNH	422793	--	1	1
43.43	-124.80	530	3-Jul-1974	SBMNH	422832	--	3	1
43.44	-124.83	570	3-Apr-1974	SBMNH	422831	--	7	1
43.47	-124.85	530	4-Jun-1974	SBMNH	422830	--	3	1
44.10	-125.38	2740	14-Jun-1972	SBMNH	422834	--	10	1
44.59	-125.59	2816	16-Mar-1970	SBMNH	422833	--	40	1
44.97	-132.24	3500	7-Oct-1972	SBMNH	422791	--	20	1
45.02	-135.23	3932	--	SBMNH	345407	--	5	4
45.03	-135.39	3990	--	SBMNH	345408	--	1	4
45.03	-134.70	3700	--	SBMNH	345405	--	45	4
45.06	-134.75	3700	--	SBMNH	345406	--	5	4
45.09	-133.18	3700	--	SBMNH	345404	--	43	4

APPENDIX 7. Localities of *Actinostola faeculenta.* *Specimens from which cnidae measurements were made.

Locality (Lat. or description)	Locality (Long. or description)	Depth (m)	Collection Date	Repository	Catalog Number	Type Status	Number of Specimens	Source
32.79	-119.51	1400	7-Jul-1989	CAS	68113	--	1	1
33.13	-118.67	757 [414 fm]	--	USNM	17803	S	6	5
33.42	-118.25	457 [250 fm]	1-Jul-1949	SBMNH	422468	--	1	1
34.03	-119.52	201 [110 fm]	Mar-1967	SBMNH	45569	--	1	1
34.08	137.98	1211 [662 fm]	20-Oct-1906	CAS	96580	--	1	1
34.47	-120.22	82 [45 fm]	Sep-1967	SBMNH	45593	--	1	1
34.49 to 34.51	-121.20 to -121.19	443	26-Oct-1997	KUIZ	001439	--	2	1
34.56 to 34.57	-122.98 to -122.96	797	25-Oct-1997	KUIZ	001440	--	3	1
34.89 to 34.91	-122.50 to -122.49	687	26-Oct-1997	KUIZ	001450	--	8	1
34.98 to 35.00	-122.55 to -122.54	481	26-Oct-1997	KUIZ	001447	--	6	1
35.01 to 35.03	-122.58 to -122.57	424	26-Oct-1997	KUIZ	001443	--	1	1
35.43 to 35.45	-122.65 to -122.65	562	27-Oct-1997	KUIZ	001453	--	9	1
35.45 to 35.46	-122.37 to -122.35	1050	27-Oct-1997	KUIZ	001459*	--	2	1
USA: California: Monterey County: off Point Sur		400	9-May-1985	CAS	67936	--	1	1
″		990–995	6-Feb-1985	CAS	96719	--	1	1
″		1000	1-Nov-1989	CAS	65166	--	2	1
″		1200	11-May-1984	CAS	183912	--	1	1
″		1200–1250	6-Feb-1985	CAS	96698	--	1	1
36.35 to 36.37	-123.82 to -123.82	817	29-Oct-1997	KUIZ	001465	--	10	1
USA: California: Monterey Bay: Monterey Canyon		1199–1409	16-Nov-1975	CAS	110754	--	1	1
36.70	-122.21	1034–1107	18-Nov-1975	CAS	21942	--	2	1
36.72 to 36.70	-122.22 to -122.18	992–1024	8-Apr-2009	KUIZ	003297	--	2	1
″	″	″	″	KUIZ	003302*	--	14	1
36.75 to 36.77	-122.46 to -122.48	2075–2250	10-Apr-2009	KUIZ	003301	--	5	1
USA: California: off San Mateo County: south of SE Farallon Island, W of Pigeon Point		183–366 [100–200 fm]	29-Dec-1971	CAS	4088	--	2	1
USA: California: Sonoma County: Bodega Bay: NNW of Bodega Head		--	16-Mar-1965	CAS	21938	--	1	1
″		549–567 [300–310 fm]	16-Mar-1965	CAS	21936	--	1	1
USA: California: Gulf of Farallones		500	13-Dec-1985	CAS	110760	--	1	1
″		913–1000	16-Dec-1985	CAS	69298	--	12	1
USA: California: Sonoma County: S side of Bodega Canyon, 24 mi. W by S of Bodega Bay		494–585 [270–320 fm]	Feb-1965	CAS	21939	--	1	1
USA: California: Humboldt County: N of Trinidad		--	Jan-1968	CAS	95143	--	1	1
43.33	-125.17	1600	4-Apr-1973	SBMNH	422451	--	3	1
″	″	1000	″	SBMNH	422456	--	2	1
43.38	-124.70	400	2-Apr-1973	SBMNH	422458	--	1	1

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APPENDIX 7. (Continued)

Locality (Lat. or description)	Locality (Long. or description)	Depth (m)	Collection Date	Repository	Catalog Number	Type Status	Number of Specimens	Source
43.39	-125.31	2000	4-Apr-1973	SBMNH	211927	--	4	1
43.43	-124.86	665	6-Jul-1974	SBMNH	422460	--	1	1
43.44	-124.81	530	26-Mar-1975	SBMNH	422444	--	2	1
43.49	-124.82	550	4-Jun-1974	SBMNH	422441	--	1	1
″	″	1200	15-Jan-1965	SBMNH	422443	--	4	1
USA: Oregon		530–603	7-Mar-1974	CAS	161245	--	3	1
44.36	-125.13	933–1097	19-Oct-1991	SBMNH	422453	--	2	1
44.40	-125.07	1000	21-Jun-1962	SBMNH	422463	--	4	1
44.40	-125.24	2000	14-Aug-1961	SBMNH	211928	--	2	1
44.46	-125.24	1100	--	SBMNH	422461	--	1	1
44.58	-124.93	800	17-Jun-1964	SBMNH	422449	--	1	1
44.58	-125.04	1250	11-Apr-1965	SBMNH	422445	--	3	1
44.59	-124.97	1000	15-Mar-1970	SBMNH	211929	--	1	1
44.60	-124.95	800	16-Jan-1968	SBMNH	422448	--	4	1
44.61	-124.94	800	10-Apr-1965	SBMNH	422467	--	1	1
44.63	-124.59	400	16-Jun-1963	SBMNH	422442	--	2	1
44.64	-124.89	600	16-Jun-1963	SBMNH	422454	--	2	1
44.65	-124.61	200	19-Feb-1964	SBMNH	422457	--	2	1
44.65	-125.15	1170	2-Oct-1970	SBMNH	422465	--	1	1
44.70	-124.97	800	14-Jan-1965	SBMNH	422462	--	2	1
USA: Oregon		700	4-Jul-1974	SBMNH	422455	--	1	1
″		800	--	SBMNH	422459	--	1	1
″		1000	--	SBMNH	422466	--	1	1
″		1250	15-Jan-1965	SBMNH	422446	--	4	1
″		2225	--	SBMNH	422452	--	2	1
45.38	-125.06	1200	4-Apr-1973	SBMNH	422480	--	4	1
45.82	-125.67	2195	4-Oct-1969	SBMNH	422464	--	1	1
45.83	-124.72	400	24-Mar-1966	SBMNH	422447	--	1	1
45.91	-124.92	800	25-Oct-1967	SBMNH	422469	--	6	1
45.96	-125.77	2265	20-Mar-1970	SBMNH	422450	--	1	1
48.17	-126.06	930–1000	7-Feb-1990	RBCM	990-00327-002	--	9	1
″	″	″	″	RBCM	990-00327-032	--	1	1
48.37 to 48.38	-126.46 to -126.47	1416–1433	29-Aug-2001	RBCM	010-00168-002	--	1	1
48.42	-126.39	1100	6-Feb-1990	RBCM	990-00325-010	--	5	1
″	″	″	″	RBCM	990-00325-030	--	1	1
48.64 to 48.64	-126.38 to -126.00	769–786	30-Aug-2001	RBCM	010-00169-001	--	2	1
48.70 to 48.67	-126.54 to -126.57	1167–1181	21-Oct-2005	RBCM	010-00184-001	--	4	1

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APPENDIX 7. (Continued)

Locality (Lat. or description)	Locality (Long. or description)	Depth (m)	Collection Date	Repository	Catalog Number	Type Status	Number of Specimens	Source
48.72	-126.51	550	25-Feb-1988	RBCM	988-00261-013	--	1	1
48.74	-126.50	461	8-Sep-1964	CAS	38004	--	4	1
CANADA: British Columbia: Vancouver Island: 32 mi. SW of Sydney Inlet		282 [154 fm]	26-May-1972	CAS	21941	--	1	1
48.95 to 48.96	-126.97 to -126.98	1054–1075	17-Apr-2003	KUIZ	003287	--	3	1
49.00 to 49.02	-126.92 to -126.94	693–719	5-Apr-2003	RBCM	010-00175-002	--	1	1
49.22	-127.12	400–500	28-Feb-1988	RBCM	988-00267-011	--	1	1
CANADA: British Columbia: Vancouver Island: Straits of Georgia: off Winchelsea Islands		426–439 [233–240 fm]	4-Dec-1963	CAS	21940	--	6	1
CANADA: British Columbia: Strait of Georgia: entrance to Howe Sound		274–366 [150–200 fm]	Dec-1963	CAS	21943	--	2	1
49.42	-127.37	1000–1166	3-Feb-1990	RBCM	990-00320-009	--	3	1
49.51	-123.28	245	19-Dec-1978	RBCM	979-11062-001	--	2	1
″	″	262	8-Mar-1982	RBCM	982-00052-002	--	1	1
49.52	-123.28	270	14-Feb-1977	RBCM	977-00016-004	--	2	1
49.71 to 49.71	-127.95 to -127.96	2003–2091	15-Apr-2003	KUIZ	003284	--	2	1
″	″	″	″	RBCM	010-00177-001	--	2	1
49.72	-128.47	2195 [1200 fm]	9-Sep-1964	CAS	38007	--	3	1
″	″	″	″	CAS	183886	--	1	1
49.80	-123.98	602	4-Dec-1982	CAS	69657	--	1	1
50.16 to 50.15	-128.73 to -128.75	1889–1910	12-Apr-2003	KUIZ	003258	--	1	1
50.90	-130.05	2195 [1200 fm]	11-Sep-1964	CAS	38005	--	4	1
51.72	-131.23	1829 [1000 fm]	5-Aug-1965	CAS	38006	--	3	1
″	″	″	″	CAS	69718	--	1	1
53.06	-132.98	1225–1240	21-Mar-1991	RBCM	991-00332-056	--	2	1
53.55	-133.63	1921	1-Aug-1965	CAS	60080	--	1	1
53.99 to 54.01	-133.61 to -133.62	490–580	3-Sep-2002	RBCM	010-00173-004	--	1	1
54.08 to 54.07	-134.12 to -134.16	1722–2083	2-Sep-2002	KUIZ	003266	--	1	1
USA: Alaska: Gulf of Alaska		462	9-Jun-2001	CAS	175120	--	3	1
″		533	22-Jun-1999	CAS	173041	--	1	1

APPENDIX 8. Localities of *Sicyonis careyi* n. sp. *Specimens from which cnidae measurements were made.

Locality (Lat. or description)	Locality (Long. or description)	Depth (m)	Collection Date	Repository	Catalog Number	Type Status	Number of Specimens	Source
USA: California: Monterey County: off Point Sur		1580–1622	26-Jul-1984	CAS	183918	--	2	1
43.72	-125.48	2997	17-Jun-1972	SBMNH	422539	--	2	1
43.74	-125.43	2992	19-Jun-1972	SBMNH	422533	--	3	1
USA: Oregon		2520	--	SBMNH	422513	--	5	1
″		2850	27-Apr-1996	CAS	110758	--	1	1
44.04	-125.09	2825	6-Oct-1969	SBMNH	422508	--	11	1
44.05	-125.39	2938	15-Jun-1972	SBMNH	422565	--	6	1
44.07	-125.40	2992	15-Jun-1972	SBMNH	422561	--	3	1
44.10	-125.38	2940	14-Jun-1972	SBMNH	211935	--	1	1
″	″	2740	14-Jun-1972	SBMNH	422551	--	3	1
44.11	-125.41	2938	15-Jul-1972	SBMNH	211932	--	4	1
44.38	-125.58	2878	4-Aug-1974	SBMNH	422550	--	5	1
44.40	-125.59	2893	4-Aug-1974	SBMNH	83595	--	7	1
44.50	-125.40	2772	9-Apr-1965	SBMNH	422518	--	7	1
44.55 to 44.53	-125.59 to -125.59	2810	27-Mar-1966	SBMNH	422520	--	9	1
44.55	-126.95	2736	8-Feb-1965	SBMNH	422544	--	1	1
44.56	-125.57	2809	14-Oct-1966	SBMNH	422517	--	5	1
44.58	-125.66	2862	17-Jul-1969	SBMNH	422547	--	3	1
44.58	-128.36	2826	3-Nov-1973	SBMNH	422534	--	1	1
44.59	-125.57	2853	15-Oct-1966	SBMNH	422510	--	13	1
44.59	-125.59	2807	15-Jul-1968	SBMNH	211930	--	7	1
″	″	2816	16-Mar-1970	SBMNH	422509	--	13	1
44.61	-125.63	2772	10-Aug-1964	SBMNH	422560	--	3	1
44.61	-126.13	2850	29-Dec-1963	SBMNH	422545	--	2	1
44.63	-125.67	2816	16-Mar-1970	CAS	184530	P	1	1
″	″	″	″	RBCM	010-00572-001	P	1	1
″	″	″	″	USNM	1149363	P	1	1
″	″	″	″	SBMNH	149660	P	2	1
″	″	″	″	SBMNH	422512	--	8	1
44.64	-126.62	2850	19-Feb-1971	SBMNH	422524	--	1	1
44.64	-126.92	2806	23-Oct-1965	SBMNH	211940	--	1	1
44.65	-125.50	2800	29-Mar-1969	SBMNH	422537	--	10	1
44.65	-125.61	2800	19-May-1964	SBMNH	211939	--	2	1
44.65	-126.67	2832	20-Feb-1971	SBMNH	422522	--	1	1
44.67	-125.68	2850	29-Dec-1963	SBMNH	422562	--	1	1
44.67	-126.35	2856	20-May-1964	SBMNH	422557	--	4	1
44.67	-126.78	2832	20-Feb-1971	SBMNH	422536	--	2	1
44.69	-125.60	2779	6-Oct-1969	SBMNH	422511	--	22	1
44.70	-125.62	2800	19-Feb-1964	SBMNH	422540	--	1	1
″	″	″	″	SBMNH	422542	--	1	1

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APPENDIX 8. (Continued)

Locality (Lat. or description)	Locality (Long. or description)	Depth (m)	Collection Date	Repository	Catalog Number	Type Status	Number of Specimens	Source
44.72	-128.38	2780	2-Feb-1973	SBMNH	422548	--	1	1
44.73	-127.46	2803	11-Dec-1972	SBMNH	422521	--	1	1
44.73	-124.50	2510	31-Oct-1967	SBMNH	211942	--	15	1
44.74	-125.62	2830	28-Mar-1969	SBMNH	422515	--	5	1
44.74	-127.43	2749	2-Feb-1973	SBMNH	422558	--	1	1
44.74	-127.48	2818	3-Feb-1973	SBMNH	422563	--	6	1
44.75	-125.61	2800	25-Jul-1967	SBMNH	211934	--	2	1
44.76	-127.40	2790	22-Oct-1965	SBMNH	422549	--	2	1
44.82	-125.66	2810	29-Oct-1967	SBMNH	422532	--	3	1
44.83	-125.58	2743	8-Mar-1972	SBMNH	422529	--	11	1
44.92	-125.58	2706	19-Jul-1969	SBMNH	422543	--	8	1
44.94	-125.66	2760	17-Mar-1970	SBMNH	422530	--	7	1
44.96	-126.62	2770	19-Feb-1971	SBMNH	422535	--	3	1
44.97	-125.74	2790	17-Mar-1970	SBMNH	422531	--	7	1
44.97	-126.60	2795	18-Feb-1971	SBMNH	422523	--	1	1
44.97	-132.25	3585	6-Oct-1972	SBMNH	211933	--	2	1
44.98	-125.74	600	7-Jun-1974	SBMNH	211938	--	1	1
″	″	2790	17-Mar-1970	SBMNH	211937	--	1	1
44.98	-132.20	3585	25-Oct-1972	SBMNH	211941	--	2	1
45.00	-127.49	2884	11-May-1973	SBMNH	422528	--	1	1
45.10	-133.18	3700	8-Oct-1972	SBMNH	211936	--	1	1
45.20	-127.54	2809	14-Mar-1973	SBMNH	422527	--	1	1
45.31	-126.53	2750	18-Feb-1971	SBMNH	422541*	H	1	1
″	″	″	″	KUIZ	003349*	P	3	1
45.34	-126.60	2750	17-Feb-1971	SBMNH	422559	--	3	1
45.35	-125.62	2500	4-Oct-1960	SBMNH	422516	--	4	1
45.40	-127.65	2811	17-May-1970	SBMNH	422525	--	1	1
45.45	-127.48	2783	3-Feb-1973	SBMNH	422552	--	2	1
45.61	-126.71	2730	17-Feb-1971	SBMNH	422556	--	2	1
45.64	-126.80	2721	17-Feb-1971	SBMNH	422546	--	3	1
45.65	-125.81	2425	19-Mar-1970	SBMNH	422514	--	6	1
45.66	-125.81	2450	19-Mar-1970	SBMNH	422519	--	15	1
45.84	-126.48	2651	17-Jan-1970	SBMNH	422555	--	2	1
45.92	-127.58	2765	17-May-1971	SBMNH	422553	--	2	1
45.94	-127.64	2763	13-Mar-1973	SBMNH	422526	--	1	1
45.95	-127.55	2763	11-Mar-1973	SBMNH	422564	--	2	1
45.96	-125.77	2265	20-Mar-1970	SBMNH	422538	--	1	1
46.03	-127.53	2740	12-Mar-1973	SBMNH	422554	--	4	1
46.04	-126.56	2706	15-Feb-1971	SBMNH	211931	--	1	1
48.73 to 48.70	-126.50 to -126.52	550	25-Feb-1988	RBCM	988-00261-028	--	21	1

APPENDIX 9. Localities of *Bathyphellia australis.*

Locality (Lat. or description)	Locality (Long. or description)	Depth (m)	Collection Date	Repository	Catalog Number	Type Status	Number of Specimens	Source
-67.92 to -67.90	-110.92 to -110.00	3954–4042	14-Apr-1965	CAS	29637	P	1	1,6
-62.92 to -62.85	-78.90 to -78.72	4575	17-Nov-1963	CAS	29636	P	1	1,6
-59.80 to -59.85	-144.75 to -144.82	3200–3259	--	USNM	60705	P	1	1,6
-58.95 to -58.97	-74.78 to -74.53	4575	9-Nov-1963	CAS	17958	P	1	1,6
-55.37 to -55.37	-78.35 to -78.13	4319	--	USNM	60194	H	1	1,6
33.97	-132.25	3585	6-Oct-1972	CAS	71096	--	2	1
34.65	-122.97	4100	17-Jun-1994	KUIZ	001270	--	153	1
″	″	″	″	KUIZ	001279	--	10	1
″	″	″	″	KUIZ	001309	--	4	1
″	″	″	20-Jul-1993	KUIZ	001368	--	14	1
″	″	″	17-Jun-1994	KUIZ	001428	--	4	1
34.67	-123.05	4100	1-May-1995	KUIZ	001297	--	90	1
34.67	-123.12	4100	22-Jul-1991	KUIZ	001352	--	5	1
34.67	-123.13	4100	9-Oct-1996	KUIZ	001271	--	58	1
″	″	″	Oct-1996	KUIZ	001433	--	6	1
34.67	-123.18	4100	1996	KUIZ	001432	--	8	1
″	″	″	3-Jun-1995	KUIZ	001269	--	83	1
″	″	″	″	KUIZ	001377	--	10	1
″	″	″	22-Sep-1994	KUIZ	001276	--	88	1
″	″	″	″	KUIZ	001373	--	9	1
″	″	″	5-Jun-1996	KUIZ	001277	--	55	1
″	″	″	9-Jun-1995	KUIZ	001303	--	34	1
″	″	″	31-May-1996	KUIZ	001378	--	24	1
″	″	″	″	KUIZ	001395	--	26	1
34.68	-123.08	4100	5-Feb-1994	KUIZ	001268	--	88	1
″	″	″	″	KUIZ	001366	--	8	1
″	″	″	10-Feb-1994	KUIZ	001367	--	9	1
34.68	-123.13	4100	30-Oct-1989	KUIZ	002167	--	16	1
″	″	″	″	CAS	75774	--	9	1
34.68	-123.18	4100	10-Feb-1994	KUIZ	001273	--	59	1
″	″	″	Feb-1994	KUIZ	001426	--	20	1
″	″	″	″	KUIZ	001427	--	10	1
34.70	-123.07	4100	20-Jul-1993	KUIZ	001300	--	45	1
34.70	-123.08	4100	17-Feb-1995	KUIZ	001274	--	81	1
34.70	-123.11	4100	1-Feb-1995	KUIZ	001376	--	8	1
34.70	-123.13	4100	20-Jul-1993	KUIZ	001362	--	8	1
″	″	″	7-Nov-1993	KUIZ	001364	--	2	1
34.70	-123.15	4100	14-Feb-1995	KUIZ	001434	--	112	1
34.70	-123.18	4100	31-Jan-1996	KUIZ	001296	--	12	1
″	″	″	″	KUIZ	001302	--	8	1

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APPENDIX 9. (Continued)

Locality (Lat. or description)	Locality (Long. or description)	Depth (m)	Collection Date	Repository	Catalog Number	Type Status	Number of Specimens	Source
34.70	-123.23	4100	22-Oct-1994	KUIZ	001374	--	4	1
″	″	″	″	KUIZ	001375	--	7	1
″	″	″	″	KUIZ	001429	--	4	1
″	″	″	″	KUIZ	001430	--	4	1
34.72	-123.03	4100	14-Nov-1995	KUIZ	001308	--	26	1
34.72	-123.10	4100	19-Jul-1993	KUIZ	001281	--	75	1
″	″	″	″	KUIZ	001361	--	9	1
″	″	″	″	KUIZ	001307	--	4	1
″	″	″	″	KUIZ	001421	--	6	1
″	″	″	″	KUIZ	001422	--	5	1
″	″	″	″	KUIZ	001423	--	5	1
″	″	″	Nov-1995	KUIZ	001431	--	3	1
″	″	″	2-Aug-1991	KUIZ	001404	--	5	1
″	″	″	″	KUIZ	001290	--	75	1
″	″	″	19-Nov-1995	KUIZ	001304	--	12	1
34.72	-123.11	4100	Aug-1991	KUIZ	001401	--	2	1
″	″	″	″	KUIZ	001402	--	3	1
″	″	″	″	KUIZ	001403	--	4	1
34.72	-123.12	4100	1-Aug-1991	KUIZ	001353	--	4	1
34.72	-123.13	4100	20-Oct-1992	KUIZ	001287	--	20	1
34.72	-123.17	4100	23-Oct-1990	KUIZ	001284	--	54	1
″	″	″	″	KUIZ	001294	--	21	1
″	″	″	″	KUIZ	001349	--	3	1
″	″	″	″	KUIZ	001350	--	3	1
″	″	″	″	KUIZ	001351	--	2	1
″	″	″	″	KUIZ	001397	--	2	1
34.72	-123.23	4100	22-Oct-1994	KUIZ	001272	--	90	1
″	″	″	12-Oct-1996	KUIZ	001275	--	91	1
34.73	-123.00	4100	24-Jun-1990	KUIZ	001299	--	15	1
34.73	-123.12	4100	22-Jul-1991	KUIZ	001288	--	67	1
34.73	-123.13	4100	21-Feb-1992	KUIZ	001298	--	45	1
″	″	″	24-Jun-1990	KUIZ	001346	--	3	1
″	″	″	25-Jun-1990	KUIZ	001347	--	4	1
″	″	″	″	KUIZ	001348	--	2	1
″	″	″	21-Feb-1992	KUIZ	001410	--	3	1
″	″	″	″	KUIZ	001411	--	3	1
″	″	″	″	KUIZ	001357	--	7	1
34.73	-123.18	4100	18-Feb-1990	KUIZ	001311	--	10	1
″	″	″	″	KUIZ	001344	--	4	1
34.73	-123.20	4100	4-Nov-1993	KUIZ	001280	--	146	1

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APPENDIX 9. (Continued)

Locality (Lat. or description)	Locality (Long. or description)	Depth (m)	Collection Date	Repository	Catalog Number	Type Status	Number of Specimens	Source
″	″	″	″	KUIZ	001363	--	8	1
″	″	″	″	KUIZ	001365	--	5	1
″	″	″	″	KUIZ	001424	--	6	1
″	″	″	″	KUIZ	001425	--	5	1
34.73	-123.22	4100	21-Aug-1994	KUIZ	001278	--	108	1
″	″	″	″	KUIZ	001295	--	11	1
″	″	″	″	KUIZ	001369	--	2	1
″	″	″	″	KUIZ	001370	--	8	1
″	″	″	″	KUIZ	001371	--	2	1
″	″	″	20-Jul-1993	KUIZ	001372	--	6	1
34.75	-123.03	4100	24-Feb-1993	KUIZ	001282	--	77	1
″	″	″	″	KUIZ	001359	--	7	1
″	″	″	″	KUIZ	001416	--	3	1
″	″	″	″	KUIZ	001417	--	3	1
″	″	″	″	KUIZ	001418	--	5	1
″	″	″	″	KUIZ	001419	--	4	1
″	″	″	″	KUIZ	001360	--	35	1
″	″	″	″	KUIZ	001415	--	3	1
″	″	″	″	KUIZ	001420	--	5	1
34.75	-123.07	4100	21-Oct-1991	KUIZ	001286	--	71	1
34.75	-123.07	4100	21-Oct-1991	KUIZ	001354	--	5	1
″	″	″	″	KUIZ	001405	--	2	1
″	″	″	″	KUIZ	001506	--	5	1
″	″	″	″	KUIZ	001407	--	4	1
″	″	″	″	KUIZ	001412	--	3	1
″	″	″	25-Oct-1991	KUIZ	001355	--	1	1
34.75	-123.12	4100	24-Jun-1991	KUIZ	001289	--	53	1
34.75	-123.18	4100	24-Jun-1991	KUIZ	001305	--	11	1
″	″	″	″	KUIZ	001399	--	5	1
″	″	″	″	KUIZ	001400	--	5	1
34.77	-123.10	4100	20-Feb-1991	KUIZ	001291	--	75	1
″	″	″	″	KUIZ	001356	--	5	1
″	″	″	″	KUIZ	001398	--	5	1
34.77	-123.13	4100	Oct-1992	KUIZ	001414	--	3	1
″	″	″	17-Oct-1992	KUIZ	001293	--	121	1
34.78	-123.07	4100	26-Feb-1992	KUIZ	001310	--	17	1
″	″	″	″	KUIZ	001408	--	4	1
″	″	″	″	KUIZ	001409	--	2	1
34.78	-123.12	4134	21-Jun-1992	KUIZ	001283	--	27	1
″	″	″	″	KUIZ	001292	--	40	1
″	″	″	″	KUIZ	001306	--	4	1

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APPENDIX 9. (Continued)

Locality (Lat. or description)	Locality (Long. or description)	Depth (m)	Collection Date	Repository	Catalog Number	Type Status	Number of Specimens	Source
″	″	″	″	KUIZ	001358	--	5	1
″	″	″	″	KUIZ	001413	--	4	1
34.80	-123.00	4100	26-Oct-1989	KUIZ	001285	--	37	1
″	″	″	″	KUIZ	001345	--	7	1
34.82	-123.12	4100	25-Jun-1989	KUIZ	001342	--	3	1
″	″	″	″	KUIZ	001343	--	3	1
″	″	″	″	KUIZ	001382	--	36	1
″	″	″	″	KUIZ	001396	--	10	1
34.83	-123.00	4100	--	--	--	--	--	7
34.83 to 34.86	-123.22 to -123.26	4080	--	KUIZ	002173	--	29	1
38.68	-126.45	4292	--	SBMNH	422491	--	15	1
39.59	-127.41	4275	9-Dec-1981	SBMNH	422487	--	20	1
40.22	-126.50	4194	14-Jan-1966	SBMNH	422506	--	4	1
USA: Oregon		--	--	CAS	71102	--	18	1
44.10	-125.38	2940	14-Jun-1972	SBMNH	211952	--	1	1
44.50	-134.73	3858	5-Jun-1970	SBMNH	211953	--	1	1
44.67	-133.62	3724	3-Jun-1970	CAS	71094	--	1	1
44.68	-133.44	3717	4-May-1970	SBMNH	422495	--	2	1
44.72	-127.38	3021	12-Jun-1974	SBMNH	422501	--	3	1
44.72	-134.72	3860	1-Mar-1967	SBMNH	422493	--	3	1
44.74	-127.43	2749	2-Feb-1973	SBMNH	422497	--	2	1
44.74	-127.48	2818	3-Feb-1973	SBMNH	422492	--	1	1
44.95	-132.19	3580	6-Oct-1971	CAS	71093	--	1	1
44.97	-133.24	3500	7-Oct-1972	CAS	71099	--	1	1
45.00	-124.49	2884	5-Nov-1973	SBMNH	422500	--	1	1
USA: Oregon		--	--	CAS	71103	--	15	1
″		2709	24-Aug-1965	CAS	71092	--	1	1
″		4200	--	SBMNH	422489	--	20	1
″		4250	--	SBMNH	422488	--	31	1
″		4250	--	SBMNH	422490	--	32	1
″		4275	--	SBMNH	422494	--	11	1
″		4300	--	SBMNH	422496	--	5	1
45.00	-132.20	3585	5-Oct-1972	CAS	71101	--	2	1
45.02	-135.23	3932	10-Oct-1972	CAS	71095	--	1	1
45.03	-127.52	2850	5-Nov-1973	SBMNH	422499	--	1	1
″	″	″	″	SBMNH	422502	--	2	1
45.04	-127.54	2838	5-Nov-1973	SBMNH	422504	--	2	1
45.04	-134.70	3980	9-Oct-1972	CAS	71097	--	1	1
45.05	-135.38	3990	11-Oct-1972	CAS	71098	--	1	1
45.53	-127.47	2780	3-Feb-1973	SBMNH	422498	--	1	1
45.92	-127.54	2765	17-May-1971	SBMNH	422503	--	2	1
45.95	-127.55	2763	11-Mar-1973	SBMNH	422505	--	1	1

APPENDIX 10. Localities of *Actinauge verrillii.*

Locality (Lat. or description)	Locality (Long. or description)	Depth (m)	Collection Date	Repository	Catalog Number	Type Status	Number of Specimens	Source
-48.15 to -48.17	148.28 to 148.25	1790–1803	--	USNM	59704	--	1	6
-45.55 to -45.50	147.30 to 147.13	2804–3100	26-Feb-1967	CAS	13747	--	11	1,6
-38.13	-75.88	1238 [677 fm]	--	--	--	S	7	5
-0.48	-89.91	717 [392 fm]	--	--	--	S	1	5
33.13	-118.67	757	8-May-1888	USNM	017807	S	8	1,5
34.56 to 34.57	-122.98 to -122.96	797	25-Oct-1997	KUIZ	001568	--	2	1
34.63	-123.02	4134	22-Jul-1992	KUIZ	001314	--	2	1
34.67	-123.05	4100	1-May-1995	KUIZ	001320	--	2	1
34.67	-123.13	4100	9-Oct-1996	KUIZ	001322	--	7	1
34.67	-123.18	4100	9-Jun-1995	KUIZ	001313	--	5	1
″	″	″	3-Jun-1995	KUIZ	001321	--	7	1
″	″	″	31-May-1996	KUIZ	001323	--	12	1
″	″	″	5-Jun-1996	KUIZ	001326	--	3	1
″	″	″	22-Sep-1994	KUIZ	001334	--	1	1
34.68	-123.18	4100	10-Feb-1994	KUIZ	001337	--	6	1
″	″	″	Feb-1994	KUIZ	001319	--	1	1
34.70	-123.05	4100	25-Oct-1991	KUIZ	001330	--	4	1
34.70	-123.08	4100	18-Feb-1995	KUIZ	001340	--	1	1
34.70	-123.15	4100	14-Feb-1995	KUIZ	001336	--	5	1
34.70	-123.23	4100	22-Oct-1994	KUIZ	001331	--	1	1
34.72	-123.10	4100	19-Nov-1995	KUIZ	001316	--	6	1
″	″	″	19-Jun-1993	KUIZ	001327	--	1	1
34.72	-123.12	4100	1-Aug-1991	KUIZ	001324	--	6	1
34.72	-123.17	4100	23-Oct-1990	KUIZ	001317	--	3	1
34.72	-123.23	4100	12-Oct-1996	KUIZ	001325	--	2	1
34.73	-123.12	4100	22-Jul-1991	KUIZ	001338	--	5	1
34.73	-123.13	4100	24-Jun-1990	KUIZ	001335	--	1	1
″	″	″	21-Feb-1992	KUIZ	001339	--	2	1
34.73	-123.18	4100	18-Feb-1990	KUIZ	001315	--	7	1
34.73	-123.20	4100	4-Nov-1993	KUIZ	001318	--	3	1
34.75	-123.03	4100	24-Feb-1993	KUIZ	001333	--	3	1
34.77	-123.10	4100	20-Feb-1991	KUIZ	001328	--	2	1
34.77	-123.13	4100	17-Oct-1992	KUIZ	001329	--	2	1
34.78	-123.12	--	21-Jun-1992	KUIZ	001332	--	1	1
34.82	-123.12	4100	25-Jun-1989	KUIZ	001341	--	1	1
34.98 to 35.00	-122.55 to -122.54	481	26-Oct-1997	KUIZ	001566	--	5	1
35.42 to 35.44	-122.50 to -122.49	898	27-Oct-1997	KUIZ	001567	--	2	1
35.81 to 35.83	-122.17 to -122.17	1071	28-Oct-1997	KUIZ	001569	--	70	1

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APPENDIX 10. (Continued)

Locality (Lat. or description)	Locality (Long. or description)	Depth (m)	Collection Date	Repository	Catalog Number	Type Status	Number of Specimens	Source
USA: California: Monterey County: Point Sur		1400–1430	6-Feb-1985	CAS	96872	--	1	1
USA: California: Monterey Bay: off Soberanes Point		1409–1384	21-Nov-1975	CAS	110759	--	77	1
36.69 to 36.71	-122.19 to -122.22	1034–1107	18-Nov-1975	CAS	21249	--	7	1
″	″	″	″	CAS	21250	--	1	1
″	″	″	″	CAS	21288	--	13	1
USA: California: off Monterey Bay		1336–1347	19-Nov-1975	CAS	104105	--	3	1
USA: California		251	22-Jun-1998	CAS	175189	--	3	1
USA: California: Farallon Islands		1463–1646 [800–900 fm]	2-Sep-1977	CAS	96877	--	10	1
43.27	-125.84	3000	27-Jul-1965	SBMNH	211949	--	3	1
43.73	-125.43	3000	17-Jun-1972	SBMNH	422680	--	6	1
43.74	-125.43	2992	16-Jun-1972	SBMNH	422678	--	8	1
USA: Oregon		400	2-Apr-1973	CAS	122247	--	4	1
USA: Oregon		2850	27-Apr-1996	CAS	110757	--	1	1
44.05	-125.39	2938	15-Jun-1972	SBMNH	422664	--	12	1
44.08	-125.41	2938	15-Jun-1972	SBMNH	422659	--	75	1
44.35	-125.23	1530	14-Oct-1964	SBMNH	422658	--	65	1
44.40	-125.59	2893	4-Aug-1974	SBMNH	83594	--	5	1
44.47	-125.54	2800	13-Jan-1965	SBMNH	422655	--	17	1
″	″	″	29-Apr-1963	SBMNH	422683	--	7	1
44.50	-125.40	2772	9-Apr-1965	SBMNH	422656	--	70	1
44.54	-125.59	2810	27-Mar-1966	SBMNH	422690	--	5	1
44.55	-128.32	2820	3-Nov-1973	SBMNH	422705	--	9	1
44.56	-125.57	2809	14-Oct-1966	SBMNH	422662	--	7	1
44.58	-125.66	2862	17-Jul-1968	SBMNH	422712	--	2	1
44.59	-125.20	1600	15-Jan-1968	SBMNH	422674	--	1	1
44.59	-125.57	2853	15-Oct-1966	SBMNH	422696	--	5	1
44.61	-125.63	2772	17-Jun-1964	SBMNH	422667	--	1	1
44.61	-126.13	3000	30-Dec-1968	SBMNH	422661	--	20	1
44.63	-125.67	2816	16-Mar-1970	SBMNH	422697	--	8	1
44.64	-126.06	2850	31-May-1963	SBMNH	422702	--	2	1
44.64	-126.92	2806	23-Oct-1965	SBMNH	422711	--	14	1
44.65	-124.61	2865	18-May-1964	SBMNH	422673	--	1	1
44.65	-125.50	2800	29-Mar-1969	SBMNH	422687	--	10	1
44.65	-125.60	2865	19-May-1964	SBMNH	422663	--	1	1
44.65	-127.46	2826	9-Feb-1965	SBMNH	422698	--	3	1
44.66	-126.08	2794	23-Oct-1965	SBMNH	422682	--	12	1
44.67	-125.68	2850	30-Oct-1963	SBMNH	422695	--	1	1

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APPENDIX 10. (Continued)

Locality (Lat. or description)	Locality (Long. or description)	Depth (m)	Collection Date	Repository	Catalog Number	Type Status	Number of Specimens	Source
44.67	-126.35	2860	20-May-1964	SBMNH	422671	--	1	1
44.67	-128.43	2794	3-Nov-1973	SBMNH	422700	--	1	1
44.68	-125.59	2800	14-Jan-1968	SBMNH	422681	--	6	1
44.68	-125.62	2800	26-Jul-1967	SBMNH	422718	--	1	1
44.69	-125.60	2779	6-Oct-1969	SBMNH	422704	--	13	1
44.69	-125.86	2833	21-Aug-1965	SBMNH	422707	--	9	1
44.70	-125.62	2800	20-Feb-1964	SBMNH	422685	--	2	1
44.71	-125.53	2825	6-Oct-1969	SBMNH	422693	--	11	1
44.72	-134.72	3860	1-Mar-1967	SBMNH	211947	--	9	1
44.73	-124.50	2510	31-Oct-1967	SBMNH	211948	--	2	1
44.73	-127.46	2803	2-Feb-1973	SBMNH	422713	--	3	1
44.74	-125.62	2830	28-Mar-1969	SBMNH	422708	--	1	1
44.74	-125.69	2800	24-Oct-1965	SBMNH	422660	--	10	1
44.74	-127.43	2749	2-Feb-1973	SBMNH	422694	--	3	1
44.74	-129.30	2709	24-Aug-1965	SBMNH	422670	--	1	1
44.75	-125.61	2800	25-Jul-1967	SBMNH	422715	--	4	1
44.75	-125.99	2800	12-Jan-1965	SBMNH	422657	--	44	1
″	″	″	12-Aug-1964	SBMNH	422688	--	9	1
44.76	-127.40	2790	22-Oct-1965	SBMNH	422672	--	1	1
44.77	-127.67	2600	17-Aug-1963	SBMNH	422669	--	1	1
44.92	-127.47	2838	4-Nov-1973	SBMNH	422699	--	4	1
44.92	-125.58	2706	16-Jul-1969	SBMNH	422689	--	6	1
44.94	-125.66	2760	17-May-1970	SBMNH	422701	--	5	1
45.00	-127.49	2884	5-Nov-1973	SBMNH	422665	--	1	1
USA: Oregon		4250	--	SBMNH	422706	--	2	1
45.01	-135.38	3990	17-Aug-1968	SBMNH	422686	--	1	1
45.03	-135.39	3990	11-Oct-1972	SBMNH	422709	--	1	1
45.06	-125.58	2652	5-Oct-1969	SBMNH	422692	--	1	1
45.30	-125.79	2605	15-Mar-1970	SBMNH	422679	--	1	1
45.35	-125.62	2500	5-Oct-1969	SBMNH	422675	--	2	1
45.58	-126.34	2661	17-Jan-1970	SBMNH	422666	--	1	1
45.60	-125.61	2283	14-Jul-1969	SBMNH	422703	--	2	1
45.66	-125.81	2450	19-Mar-1970	SBMNH	422684	--	3	1
45.94	-127.64	2763	13-Mar-1973	SBMNH	422668	--	1	1
45.95	-127.55	2763	11-Mar-1973	SBMNH	422677	--	1	1
45.96	-126.63	2743	14-Jan-1971	SBMNH	422676	--	1	1
48.22	-125.82	512	14-Jun-1985	RBCM	985-00471-011	--	1	1
48.28 to 48.27	-125.96 to -125.96	466–470	13-Oct-2005	RBCM	010-00182-001	--	1	1

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APPENDIX 10. (Continued)

Locality (Lat. or description)	Locality (Long. or description)	Depth (m)	Collection Date	Repository	Catalog Number	Type Status	Number of Specimens	Source
48.33 to 48.32	-126.40 to -126.37	1160–1175	3-Sep-2001	RBCM	010-00172-001	--	3	1
48.41 to 48.39	-126.10 to -126.09	275	8-Feb-1972	RBCM	A-241-00004	--	1	1
48.42 to 48.41	-126.34 to -126.45	1100	6-Feb-1990	RBCM	990-00325-028	--	4	1
48.43 to 48.40	-126.14 to -126.14	315	23-Feb-1988	RBCM	988-00258-002	--	24	1
48.73 to 48.70	-126.50 to -126.52	550	25-Feb-1988	RBCM	988-00261-031	--	25	1
49.07	-126.93	458–462	22-Jul-1999	RBCM	009-00055-011	--	2	1
49.17 to 49.19	-127.07 to -127.09	526–569	5-Apr-2003	KUIZ	003251	--	2	1
49.22 to 49.21	-127.07 to -127.05	400–500	28-Feb-1988	RBCM	988-00267-021	--	4	1
49.35	-127.26	560–660	27-Jul-1999	RBCM	010-00083-008	--	2	1
49.42	-127.37	1000–1166	3-Feb-1990	RBCM	990-00320-033	--	1	1
51.20 to 51.22	-130.04 to -130.07	571–621	15-Oct-2006	RBCM	010-00193-003	--	8	1
52.00	-131.23	--	10-Mar-1991	RBCM	991-00327-001	--	2	1
USA: Alaska: Aleutian Islands		332	3-Jun-2002	CAS	175091	--	1	1
USA: Alaska: Aleutian Islands		1039	30-Jun-2004	CAS	175936	--	3	1
USA: Alaska: Aleutian Islands		529–539	21-May-1999	CAS	183893	--	8	1
52.03 to 52.00	-131.60 to -131.57	1636–1900	30-Aug-2000	RBCM	009-00078-015	--	1	1
52.08 to 52.09	-131.53 to -131.52	1396–1523	5-Aug-2004	RBCM	010-00216-005	--	5	1
CANADA: British Columbia: Oueen Charlotte Islands: W coast of Moresby Island		732 [400 fm]	Jul-1977	RBCM	001-00048-001	--	4	1
52.75 to 52.74	-132.43 to -132.41	819–936	7-Sep-2004	RBCM	010-00181-001	--	3	1
53.02	-132.92	1189 [650 fm]	Aug-1965	CAS	21251	--	13	1
53.06	-132.98	1225–1240	21-Mar-1991	RBCM	991-00332-013	--	5	1
″	″	″	″	RBCM	991-00332-043	--	20	1
″	″	″	″	RBCM	991-00332-051	--	1	1
53.40	-130.11	315 [172 fm]	15-Sep-1978	CAS	28467	--	5	1
54.34 to 54.35	-133.06 to -133.02	457–466	1-Sep-2002	KUIZ	003271	--	10	1
55.55	-133.63	1920 [1050 fm]	Aug-65	CAS	21253	--	1	1
USA: Alaska: Gulf of Alaska: off Kodiak Island		119–123 [65-67 fm]	26-Sep-1978	CAS	96869	--	3	1
USA: Alaska: Gulf of Alaska: S of Kodiak Island		238 [130 fm]	14-Sep-1963	CAS	21255	--	2	1
57.29	-136.29	--	16-Sep-1996	KUIZ	001148	--	1	1
59.14	-141.55	325.7	11-Nov-1979	CAS	20192	--	1	1

APPENDIX 11. Localities of *Monactis vestita.*

Locality (Lat. or description)	Locality (Long. or description)	Depth (m)	Collection Date	Repository	Catalog Number	Type Status	Number of Specimens	Source
12.50	-64.75	3476–3518	--	--	--	--	17	8
13.75	-67.75	5047	--	--	--	--	49	8
″	″	5046	--	--	--	--	22	8
14.50	-67.25	5055–5060	--	--	--	--	65	8
15.13	-69.20	3993–4065	--	--	--	--	21	8
″	″	3967-–4009	--	--	--	--	19	8
32.47	-16.63	2286	--	MOM	13 0080	S	2	9
38.91	-21.21	5005	--	MOM	13 0022	S	11	9
41.82 to 41.66	-13.91 to -13.80	5320	--	--	--	--	5	8
42.96 to 42.87	-14.89 to -14.79	5200	--	--	--	--	3	8
44.68	-133.44	3717	5-Apr-1970	SBMNH	144459	--	19	1,4
45.02	-135.23	3932	10-Oct-1972	KUIZ	001210	--	11	1,4
″	″	″	″	SBMNH	144419	--	248	1,4
″	″	″	″	CAS	119154	--	6	1,4
45.03	-134.70	3900	9-Oct-1972	SBMNH	144423	--	153	1,4
″	″	″	″	RBCM	999-00262-001	--	3	1,4
45.03	-135.39	3990	--	LACM	1972-386.001	--	7	4
″	″	″	10-Oct-1972	SBMNH	144460	--	74	1,4
45.06	-134.75	3900	10-Oct-1972	SBMNH	144461	--	71	1,4
″	″	″	--	USNM	100314	--	5	4
45.08	-133.18	3700	7-Oct-1972	SBMNH	144422	--	11	1,4
45.09	-134.72	3900	9-Oct-1972	SBMNH	144424	--	39	1,4
46.52	-10.33	4706	--	--	--	--	7	8
60.63	-8.62	350	25-Jul-1989	--	--	--	--	10
60.67	-11.68	914	26-Jul-1989	--	--	--	--	10
60.74	-12.62	702	28-Jul-1989	--	--	--	--	10
60.80	-12.68	1006	28-Jul-1989	--	--	--	--	10
60.95	-4.31	1150	21-Jul-1989	--	--	--	--	10
62.08	-6.66	59	--	--	--	--	--	10

APPENDIX 12. Localities of *Paraphelliactis pabista.*

Locality (Lat. or description)	Locality (Long. or description)	Depth (m)	Collection Date	Repository	Catalog Number	Type Status	Number of Specimens	Source
26.99 to 27.02	-111.41 to -114.41	2033–2034	9-10-Oct-1990	--	--	--	2	11
27.00	-111.40	1950–2050	11-Oct-1990	--	--	--	1	11
″	″	2000	--	--	--	--	3	11
34.67	-123.18	4100	31-May-1996	KUIZ	003314	--	1	1
34.82	-123.12	4100	25-Jun-1989	CAS	75776	--	1	1
43.27	-125.84	3000	27-Jul-1965	SBMNH	211921	--	7	1
43.33	-125.17	1600	4-Apr-1973	SBMNH	422736	--	1	1
43.39	-125.31	2000	4-Apr-1973	SBMNH	422732	--	1	1
USA: Oregon		2810	--	CAS	65149	--	7	1
USA: Oregon		2500	1-Aug-1965	CAS	65151	--	2	1
44.05	-125.39	2938	15-Jun-1972	SBMNH	422749	--	1	1
44.38	-125.58	2878	4-Aug-1974	SBMNH	422729	--	7	1
44.40	-125.24	2000	14-Aug-1961	SBMNH	422733	--	2	1
44.40	-125.59	2893	4-Aug-1974	SBMNH	83592	--	7	1
44.45	-125.26	2000	14-Aug-1961	SBMNH	422727	--	22	1
44.45	-132.23	3655	1-Jun-1970	SBMNH	422753	--	1	1
44.47	-125.54	2800	13-Jan-1965	SBMNH	422738	--	8	1
44.50	-125.40	2772	9-Apr-1965	SBMNH	422759	--	5	1
44.50	-134.73	3858	--	SBMNH	422752	--	4	1
44.56	-125.57	2809	14-Oct-1966	SBMNH	422735	--	1	1
″	″	″	″	SBMNH	422751	--	3	1
44.58	-125.57	2807	15-Jul-1968	SBMNH	422731	--	2	1
44.58	-128.36	2820	3-Nov-1973	SBMNH	211914	--	1	1
44.59	-125.58	2853	15-Oct-1966	CAS	65148	--	2	1
44.59	-125.59	2800	29-Apr-1963	SBMNH	422743	--	1	1
″	″	2816	16-Mar-1970	SBMNH	422730	--	2	1
44.63	-125.67	2816	16-Mar-1970	SBMNH	422734	--	2	1
44.64	-126.68	2938	20-Feb-1971	SBMNH	211918	--	3	1
44.66	-125.21	1426	1961	SBMNH	211976	--	1	1
44.67	-128.19	2700	22-Oct-1965	SBMNH	422747	--	1	1
44.67	-133.60	3724	3-Jun-1970	SBMNH	211919	--	3	1
44.68	-125.59	2800	14-Jan-1968	SBMNH	422744	--	6	1
44.68	-125.62	2800	26-Jul-1967	SBMNH	83609	--	4	1
44.69	-125.60	2779	6-Oct-1969	SBMNH	422758	--	6	1
44.73	-127.46	2803	11-Oct-1972	SBMNH	422741	--	1	1
44.74	-125.62	2830	28-Mar-1969	SBMNH	422760	--	7	1
44.74	-125.69	2800	15-Oct-1966	CAS	65150	--	3	1

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APPENDIX 12. (Continued)

Locality (Lat. or description)	Locality (Long. or description)	Depth (m)	Collection Date	Repository	Catalog Number	Type Status	Number of Specimens	Source
44.75	-125.61	2800	25-Jul-1967	SBMNH	422754	--	3	1
44.91	-132.23	3685	5-Oct-1972	SBMNH	422750	--	2	1
44.92	-125.58	2706	4-Jul-1974	SBMNH	211916	--	1	1
44.92	-127.48	2838	4-Nov-1973	SBMNH	211917	--	2	1
44.94	-125.66	2760	17-Mar-1970	SBMNH	211915	--	1	1
44.95	-132.19	3580	5-Oct-1972	SBMNH	422745	--	2	1
44.97	-125.74	2790	19-Mar-1970	SBMNH	422748	--	1	1
44.97	-132.24	3500	6-Oct-1972	SBMNH	422757	--	2	1
″	″	3585	6-Oct-1972	SBMNH	422737	--	1	1
45.03	-127.52	2850	5-Nov-1973	SBMNH	422742	--	1	1
45.03	-134.70	3900	9-Oct-1972	SBMNH	422761	--	2	1
45.06	-125.58	2652	5-Oct-1969	SBMNH	422755	--	1	1
45.07	-133.18	3900	7-Oct-1972	SBMNH	211920	--	3	1
45.09	-134.72	3900	9-Oct-1972	SBMNH	422746	--	1	1
45.95	-127.55	2763	11-Mar-1973	SBMNH	422739	--	1	1
46.03	-127.53	2740	12-Mar-1973	SBMNH	422740	--	1	1
48.09	-126.18	1515	1984 [?]	CAS	50135	--	1	1
48.15	-127.07	2510	10-Sep-1971	SBMNH	422756	--	2	1
49.71	-127.95	2003–2091	15-Apr-2003	RBCM	010-00177-002	--	1	1
49.89	-127.38	1830	10-Sep-1964	CAS	28043	P	1	1,12
50.45	-130.12	1859–1903	8-Oct-2006	RBCM	010-00188-002	--	2	1
50.91	-130.10	2195 [1200 fm]	11-Sep-1964	CAS	25997	--	38	1,12
″	″	″	″	RBCM	982-00001-001	P	2	1,12
″	″	″	″	CMN	1982-0041	P	1	12
″	″	″	″	USNM	60379	P	2	12
51.26 to 51.27	-130.17 to -130.19	2003–2091	15-Apr-2003	KUIZ	003286	--	1	1
51.45	-131.79	2430	8-Aug-1965	CAS	25998	--	3	1,12
″	″	″	″	CAS	25999	P	2	1,12
51.72	-131.23	1829 [1000 fm]	5-Aug-1965	CAS	26000	P	2	1,12
″	″	″	″	CMN	1982-0038	H	1	12
53.55	-133.63	1920 [1050 fm]	Aug-1965	CAS	28040	P	1	1,12
53.55	-133.63	1920 [1050 fm]	Aug-1965	CAS	28041	--	2	1,12

APPENDIX 13. Localities of *Liponema brevicorne.*

Locality (Lat. or description)	Locality (Long. or description)	Depth (m)	Collection Date	Repository	Catalog Number	Type Status	Number of Specimens	Source
32.74 to 32.84	-119.48 to -119.54	1400	7-Jul-1989	CAS	68111	--	4	1
33.13	-118.67	757 [414 fm]	--	USNM	17802	S	2	5
34.63	-123.02	4134	22-Jul-1992	KUIZ	001380	--	1	1
34.65	-122.97	4100	17-Jun-1994	KUIZ	001384	--	1	1
34.67	-123.13	4100	9-Oct-1996	KUIZ	001389	--	1	1
34.67	-123.18	4100	3-Jun-1995	KUIZ	001388	--	1	1
″	″	″	5-Jun-1996	KUIZ	001950	--	1	1
34.67	-123.23	4100	12-Oct-1992	KUIZ	001390	--	1	1
34.68	-123.13	4100	30-Oct-1989	CAS	75775	--	5	1
34.70	-123.08	4100	17-Feb-1995	KUIZ	001387	--	1	1
34.70	-123.15	4100	14-Feb-1995	KUIZ	001386	--	1	1
34.72	-123.10	4100	19-Jul-1993	KUIZ	001383	--	3	1
34.73	-123.13	4100	24-Jun-1990	KUIZ	001379	--	1	1
34.73	-123.22	4100	21-Aug-1994	KUIZ	001385	--	1	1
34.75	-123.07	4100	21-Oct-1991	KUIZ	001951	--	1	1
34.77	-123.13	4100	18-Oct-1992	KUIZ	001381	--	1	1
34.98 to 35.00	-122.55 to -122.54	481	26-Oct-1997	KUIZ	001449	--	3	1
36.13	129.82	732 [400 fm]	30-Jul-1906	CAS	3829	--	1	1,13
USA: California: Monterey County: off Point Sur		1000	Nov-1989	CAS	65165	--	2	1
USA: California: Monterey County: off Point Sur		1200	11-May-1984	CAS	183894	--	4	1
USA: California: Monterey County: off Point Sur		1200–1250	6-Feb-1985	CAS	67930	--	1	1
USA: California: Monterey County: off Point Sur		1400–1430	6-Feb-1985	CAS	66642	--	4	1
USA: California: Monterey County: off Point Sur		1580–1622	26-Jul-1984	CAS	69282	--	1	1
JAPAN: off E coast of Northern Honshu		487	--	CAS	--	--	5	13
36.49	-122.32	1409–1419	3-Oct-1984	CAS	66641	--	4	1
36.61	-122.43	~3000	--	--	--	--		14
36.72 to 36.70	-122.22 to -122.18	992–1024	8-Apr-2009	KUIZ	003303	--	2	1
USA: California		461	14-Jul-2001	CAS	175192	--	3	1
USA: California: Gulf of Farallones		510	13-Dec-1985	CAS	95090	--	3	1
USA: California: Gulf of Farallones		510	13-Dec-1985	CAS	96834	--	2	1
38.12	142.13	486 [266 fm]	10-Oct-1906	CAS	3826	--	5	1
PACIFIC OCEAN: between Korea and Japan		732	1906	CAS	--		1	
JAPAN: N of Hokkaido		549	1906	CAS	--	--	1	13
43.73	-125.43	3000	17-Jun-1972	SBMNH	422777	--	6	1
USA: Oregon		1700–2000	1-May-1996	CAS	110756	--	1	1
44.08	145.50	548 [300 fm]	30-Sep-1906	CAS	3827	--	1	1
44.10	-125.38	2940	14-Jun-1972	SBMNH	422778	--	1	1
44.35	-125.23	1530	14-Aug-1964	SBMNH	422771	--	12	1
44.40	-125.07	1000	21-Jun-1962	SBMNH	422781	--	2	1
44.40	-125.17	1000	12-Aug-1964	SBMNH	422776	--	2	1
44.45	-125.22	1400	20-Jun-1962	SBMNH	422785	--	1	1
44.58	-125.04	1250	11-Apr-1965	SBMNH	422782	--	1	1
44.58	-125.66	2862	17-Jul-1968	SBMNH	422787	--	4	1
44.59	-125.20	1600	15-Jan-1968	SBMNH	422789	--	1	1

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APPENDIX 13. (Continued)

Locality (Lat. or description)	Locality (Long. or description)	Depth (m)	Collection Date	Repository	Catalog Number	Type Status	Number of Specimens	Source
USA: Oregon: off Newport		256	--	USNM	53305	--	1	13
44.69	-125.86	2833	21-Aug-1965	SBMNH	422779	--	1	1
44.73	-124.50	2510	31-Oct-1967	SBMNH	211950	--	1	1
44.74	-124.31	2030	31-Oct-1967	SBMNH	211951	--	18	1
44.76	-127.40	2790	22-Oct-1965	SBMNH	422780	--	1	1
45.00	-127.49	2884	5-Nov-1973	SBMNH	422786	--	1	1
45.03	-127.52	2850	5-Nov-1973	SBMNH	422788	--	1	1
45.06	-125.58	2652	Oct-1969	SBMNH	422790	--	1	1
45.83	-125.23	1540	26-Jul-1967	SBMNH	422774	--	33	1
45.86	-125.26	1600	25-Oct-1967	SBMNH	422784	--	3	1
46.03	-127.53	2740	12-Mar-1973	SBMNH	422783	--	1	1
46.73	144.03	933 [510 fm]	26-Sep-1906	CAS	3819	--	2	1,13
48.37 to 48.38	-126.46 to -126.47	1416–1433	29-Aug-2001	RBCM	010-00168-003	--	1	1
48.43 to 48.40	-126.14 to -126.14	315	23-Feb-1988	RBCM	988-00258-001	--	1	1
48.44 to 48.43	-126.39 to -126.37	1068–1101	29-Aug-2001	RBCM	010-00167-001	--	1	1
48.61	-127.01	2189	11-Sep-1971	SBMNH	422775	--	7	1
48.73 to 48.70	-126.50 to -126.52	550	25-Feb-1988	RBCM	988-00261-020	--	3	1
49.17 to 49.19	-127.07 to -127.09	526–569	5-Apr-2003	KUIZ	003253	--	1	1
49.33 to 49.37	-127.23 to -127.28	560–660	27-Jul-1999	RBCM	010-00083-004	--	2	1
49.51 to 49.51	-127.82 to -127.84	1955–2001	16-Apr-2002	KUIZ	003280	--	1	1
49.66 to 49.67	-127.60 to -127.61	580–584	16-Apr-2003	RBCM	010-00178-001	--	1	1
49.66 to 49.67	-127.60 to -127.84	580–584	14-Apr-2003	KUIZ	003250	--	2	1
51.72	-127.79	--	21-Oct-1982	KUIZ	002155	--	1	1
51.87	-127.94	318–320	19-Jan-1988	RBCM	988-00003-021	--	11	1
USA: Alaska: Aleutian Islands		--	10-Jul-2002	CAS	183892	--	2	1
USA: Alaska: Gulf of Alaska: vicinity of Aleutian Islands		299	18-May-1999	CAS	161246	--	1	1
52.03 to 52.00	-131.60 to -131.57	1636–1900	30-Aug-2001	RBCM	009-00078-005	--	1	1
53.06	-132.98	1225–1240	21-Mar-1991	RBCM	991-00332-026	--	4	1
″	″	″	″	RBCM	991-00332-059	--	2	1
53.92	-133.82	1150	22-Mar-1991	RBCM	991-00333-030	--	1	1
54.08 to 54.07	-134.12 to -134.16	1722–2083	2-Sep-2002	KUIZ	003267	--	1	1
BERING SEA: Bowers Bank		1019	1906	CAS	--	--	1	13
CANADA: British Columbia: North of Queen Charlotte Islands: Dixon Entrance		187 [102 fm]	28-May-1965	CAS	19868	--	2	1
54.55	178.75	1019 [557 fm]	4-Jun-1906	CAS	3828	--	1	1,13
USA: Alaska: Aleutian Islands: north of Unalaska Island		580–680	10-Jun-1979	CAS	96532	--	1	1
54.83	147.20	102 [56 fm]	14-Jun-1906	CAS	3805	--	1	1
55.07 to 55.08	-130.19 to -130.19	215–225	24-Jan-1988	RBCM	988-00012-016	--	2	1
55.51	-166.68	135	May-1976	--	--	--	14	13
55.52	-166.68	135	31-May-1976	CAS	3800	--	6	1
″	″	″	″	CAS	3801	--	2	1
55.52	-166.68	135	31-May-1976	CAS	3802	--	1	1
″	″	″	″	CAS	3803	--	1	1
″	″	″	″	CAS	3804	--	1	1
RUSSIA: off E coast of Kamchatka		103	1906	CAS	--	--	1	13
USA: Alaska: Gulf of Alaska		533	22-Jun-1999	CAS	175117	--	1	1
--	--	--	17-Sep-1978	CAS	24433	--	2	1

APPENDIX 14. Localities of *Metridium farcimen.*

Locality (Lat. or description)	Locality (Long. or description)	Depth (m)	Collection Date	Repository	Catalog Number	Type Status	Number of Specimens	Source
MEXICO: Guerrero: Acapulco bay		--	4-Apr-1932	CAS	96534	--	1	1
MEXICO: Sonora: Gulf of California: Guaymas		--	--	USNM	49458	H	1	15
MEXICO: Sonora: Gulf of California: Guaymas		--	--	MZLU	331	H	wedge	15
31.36	-113.63	--	7-Mar-1970	SBMNH	422766	--	1	1
32.68	-117.28	60 [33 fm]	10-Aug-1978	SBMNH	422767	--	1	1
34.25	-120.00	366 [200 fm]	1967	SBMNH	45514	--	1	1
34.47	-120.22	293 [160 fm]	Oct-1968	SBMNH	45513	--	1	1
″	″	256 [140 fm]	Sep-1967	SBMNH	45511	P	1	16
″	″	201 [110 fm]	1-Jul-1967	SBMNH	45512	P	1	16
34.49 to 34.51	-121.20 to -121.19	443	26-Oct-1997	KUIZ	001438	--	1	1
35.03 to 35.04	-121.10 to -121.10	199	24-Oct-1997	KUIZ	001435	--	5	1
″	″	″	″	KUIZ	001436	--	5	1
USA: California: 7.4 mi SSW of Point Piedras Blanca		441–457 [241–250 m]	19-Jul-1977	CAS	96875	--	1	1
36.35 to 36.37	-123.82 to -123.82	817	29-Oct-1997	KUIZ	001464	--	1	1
36.63	-121.93	73–77 [40–42 fm]	10-May-1904	CAS	3349	H	1	1,16
USA: California: Monterey Bay		--	17-Apr-1980	CAS	96541	--	1	1
USA: California: Monterey Bay		55 [30 fm]	8-Feb-1970	CAS	108537	--	1	1
USA: California: Monterey Bay		88 [48 fm]	8-Feb-1970	CAS	108457	--	1	1
USA: California: Monterey Bay		104 [57 fm]	8-Feb-1970	CAS	108536	--	1	1
37.82	-122.48	84	21-Oct-1912	USNM	85789	P	1	16
″	″	60–84 [33–46 fm]	15-Oct-1912	CAS	4371	--	4	1
″	″	--	21-Oct-1912	CAS	4372	--	2	1
″	″	73–75 [40–41 fm]	15-Oct-1912	CAS	4370	P	2	1,16
USA: California: Cordell Bank National Marine Sanctuary		183 m [100 fm]	18-Jun-1951	CAS	3508	P	2	1,16
USA: California: Sonoma County: Bodega Jetty		--	12-Jun-1952 [?]	CAS	95086	--	1	1
USA: California: Humboldt County: Eel River Canyon		--	Dec-1966	CAS	3341	--	1	1
44.10	-125.38	2740	14-Jun-1972	SBMNH	422765	--	2	1
44.73	-124.31	--	25-Mar-1964	SBMNH	422768	--	1	1
46.14 to 46.16	-124.22 to -124.23	86	21-Apr-1975	SBMNH	422769	--	1	1
48.30	-123.37	9 [30 ft]	18-Sep-1973	RBCM	973-00251-012	--	2	1
48.30	-123.53	12.2	6-Sep-1973	RBCM	973-00249-010	--	6	1
48.50	-122.68	--	--	--	--	--	--	17
48.73 to 48.73	-123.43 to -123.44	75–95	15-May-1978	RBCM	978-00146-005	--	1	1
48.76	-123.45	73–128 [40–70 ft]	10-Feb-1965	RBCM	A-120-00002	--	2	1
48.87	-123.31	--	30-Sep-1986	RBCM	986-00197-008	--	12	1
48.90	-125.32	<15	12-Jul-1973	RBCM	973-00176-002	--	2	1
CANADA: British Columbia: Boundary Bay: Crescent Beach		--	1917	CAS	3505	--	1	1
CANADA: British Columbia: Strait of Georgia: N of Gabriola Island		15+ [50+ ft]	2-Jul-1963	CAS	19869	--	3	1

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APPENDIX 14. (Continued).

Locality (Lat. or description)	Locality (Long. or description)	Depth (m)	Collection Date	Repository	Catalog Number	Type Status	Number of Specimens	Source
49.37	-122.88	--	Jan-1960	RBCM	976-00036-012	--	1	1
49.38	-126.27	0–3 [0–10 ft]	12-Jul-1980	RBCM	980-00400-004	--	1	1
49.53	-124.82	--	17-Jun-1976	RBCM	989-00040-001	--	3	1
49.59	-127.09	--	26-Jun-1976	RBCM	989-00039-001	--	1	1
49.95 to 50.00	-127.67 to -127.68	108–120	21-Mar-1986	RBCM	986-00095-001	--	2	1
50.05 to 50.09	-127.25 to -127.25	210	20-Nov-1983	RBCM	983-01645-008	--	3	1
50.72	-127.49	--	26-Jun-1976	RBCM	989-00036-002	--	7	1
52.18	-131.13	26.2	28-Jun-1999	RBCM	999-00212-001	--	1	1
52.20 to 52.19	-131.25 to -131.25	54.8–63.5	17-Jun-1999	RBCM	999-00210-003	--	2	1
52.41	-131.60	--	30-Mar-1991	RBCM	991-00330-058	--	1	1
52.90 to 52.91	-128.68 to -128.68	198–220	31-Oct-1986	RBCM	987-00313-001	--	1	1
RUSSIA: Kamchatka: Avacha Bay		--	--	--	--	S	--	18
52.99	-130.76	52 f	13-Sep-1978	CAS	25556	--	4	1
RUSSIA: Kamchatka: Petropaulowsk		--	--	--	--	S	--	19
53.10 to 53.11	-130.88 to -130.92	84	29-Jan-1986	RBCM	986-00064-002	--	3	1
53.60	-130.55	--	22-Jun-2005	RBCM	005-00054-025	--	1	1
USA: Alaska: Alexander Archipelago: Dutch Harbor		--	Sep-1897	CAS	21326	--	2	1
54.15	-130.23	--	27-Oct-1974	RBCM	975-00315-001	--	1	1
54.19 to 54.21	-131.07 to -131.07	77	6-Feb-1986	RBCM	986-00080-010	--	5	1
54.20 to 54.23	-131.06 to -131.05	0	6-Feb-1986	RBCM	986-00079-011	P	1	1,16
54.23 to 54.25	-131.04 to -131.04	123	6-Feb-1986	RBCM	986-00078-001	--	6	1
54.81	-130.43	9	9-Jun-1974	RBCM	974-00218-026	--	1	1
USA: Alaska: Bering Sea: Alaska Peninsula: off S end Izembek Lagoon		43	26-Jun-1982	CAS	27732	--	1	1
USA: Alaska: Bering Sea: Alaska Peninsula: off S end Izembek Lagoon		62–63	18-Oct-1982	CAS	27700	--	1	1
USA: Alaska: Bering Sea: Alaska Peninsula: SW of Port Moller		42–44	12-Aug-1982	CAS	27710	--	1	1
USA: Alaska: Bering Sea: Alaska Peninsula: SW of Port Moller		20	Oct-1982	CAS	27718	--	1	1
USA: Alaska: Bering Sea: Alaska Peninsula: off Port Moller		55	11-Aug-1982	CAS	27708	--	1	1
USA: Alaska: Bering Sea: Alaska Peninsula: off Port Moller		50–51	21-Oct-1982	CAS	27733	--	1	1
USA: Alaska: Bering Sea: Alaska Peninsula: NE of Cape Leontovich		43–46	13-Aug-1982	CAS	27724	--	1	1
USA: Alaska: Bering Sea: east of Pribilof Islands		66	7-Jul-1979	CAS	21859	--	13	1
56.77	-151.72	220	9-Sep-1963	CAS	69721	--	2	1
USA: Alaska: Kodiak Island		--	--	CAS	95100	--	2	1
USA: Alaska: Gulf of Alaska: off Kodiak Island		119–123 [65–67 fm]	26-Sep-1978	CAS	96876	--	1	1
57.94	-173.02	116.0–117.1	27-May-1976	CAS	19826	--	4	1
USA: Alaska: Bering Sea		45	22-May-1976	CAS	26120	--	1	1
65.68	-168.30	--	10-Aug-2004	KUIZ	002949	--	2	1
--		--	--	CAS	3348	--	1	1

APPENDIX 15. Localities of *Sagartiogeton californicus.* * Cnidae measurements made from specimens.

Locality (Lat. or description)	Locality (Long. or description)	Depth (m)	Collection Date	Repository	Catalog Number	Type Status	Number of Specimens	Source
27.07	-111.90	73 [40 fm]	11-Apr-1936	--	--	S	2	20
34.89 to 34.91	-122.50 to -122.49	687	26-Oct-1997	KUIZ	001451*	N	1	1
″	″	″	″	KUIZ	003353*	--	1	1
36.52 to 36.71	-122.19 to -122.22	1034–1107	18-Nov-1975	CAS	53178	--	2	1
36.80 to 36.81	-123.80 to -123.79	464	30-Oct-1997	KUIZ	001468	--	2	1
USA: California: Gulf of Farallones		913–925	16-Dec-1985	CAS	96824	--	7	1
USA: California: Farallon Islands		1463–1646 [800–900 fm]	2-Sep-1977	CAS	183903	--	1	1
43.43	-124.86	658	4-Jul-1974	SBMNH	83608*	--	14	1
″	″	665	--	SBMNH	144420*	--	11	1
43.45	-124.81	530	--	SBMNH	144446*	--	27	1
44.61	-124.94	800	10-Apr-1965	SBMNH	144418	--	1	1
44.67	-126.07	630	19-Feb-1970	SBMNH	144447	--	10	1
48.73 to 48.70	-126.50 to -126.52	550	25-Feb-1988	RBCM	988-00261-029	--	42	1
48.95 to 48.96	-126.97 to -126.98	1054–1075	17-Apr-2003	KUIZ	003290	--	1	1
49.33 to 49.37	-127.23 to -127.28	560–660	27-Jul-1999	RBCM	010-00083-009	--	1	1
49.42	-127.37	1000–1166	3-Feb-1990	RBCM	990-00320-012	--	7	1
49.51 to 49.50	-127.41 to -127.41	823–1028	9-Apr-2003	KUIZ	003278	--	1	1
49.89 to 49.89	-127.87 to -127.87	840–863	14-Apr-2003	KUIZ	003262	--	1	1
50.83 to 50.83	-126.56 to -126.57	120–130	23-Mar-1980	RBCM	980-00255-011	--	1	1
51.20 to 51.22	-130.04 to -130.07	571–621	15-Oct-2006	RBCM	010-00193-004	--	2	1
53.06	-132.98	1225–1240	21-Mar-1991	RBCM	991-00332-054	--	1	1
53.99 to 54.01	-133.61 to -133.62	490–580	3-Sep-2002	RBCM	010-00173-002	--	6	1